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MYCOTAXON

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Volume LIII

January-March 1995

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HYGROPHORACEAE (AGARICALES) IN NEW YORK STATE
AND ADJACENT AREAS.1. INTRODUCTION AND HYGROCYBE SUBSECT. SQUAMULOSAE.¹

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ABSTRACT

A key is provided to nine taxa of *Hygrocybe* subsect. *Squamulosae*, recorded from New York and adjacent areas. Extensive descriptions based on fresh sporocarps are provided of seven taxa. The new combination *Hygrocybe squamulosa* (Ell. & Ev.) Arnolds is made. Two species, *Hygrocybe reidii* and *H. calcephila*, are reported for the first time from North-America.

INTRODUCTION

From July until November 1986 I had the opportunity to collect Hygrophoraceae during a stay as a postdoctoral fellow at Cornell University with financial support of the Anna E. Jenkins Fund. In the preceding years I was involved in taxonomic and ecological studies of this group of agarics in northwestern Europe, in particular the Netherlands. Revisions of *Hygrophorus*, *Hygrocybe* and *Camarophyllopsis* in that country have recently been published (Arnolds, 1990a,b). These genera are relatively well-known in North America as well, in particular due to the monograph of *Hygrophorus* (sensu lato) by Hesler & Smith (1963). Since their publication several new taxonomic characters have been found in this group, for instance a more detailed classification of the hymenophoral trama (Arnolds, 1974; Kühner, 1976) and the importance of the number of nuclei of basidiospores (Kühner, 1976). Together with more accurate morphological studies these developments have resulted in Europe in the discovery of many undescribed taxa, altered species concepts in other cases and new classifications of higher taxonomic units (e.g. Bon, 1990; Arnolds, 1990a,b;

¹Comm.no. 517 of the Biological Station, Wijster

Kovalenko, 1989). It is to be expected that they have repercussions for the taxonomy of North American species as well.

A problem encountered by all workers on this group is the comparison of European and North American taxa. Hesler & Smith (1963) adopted many European names, but were often in doubt whether this was justified, although they studied some exsiccata of European species. On the other hand, several North American names are used in Europe. Due to the importance of macroscopic characters in this group, which are partially only recognizable in fresh sporocarps (e.g. subtle differences in colours and the viscosity of pileus and stipe), it is often not possible to draw solid conclusions on the basis of exsiccata only. Therefore, one of my aims was to compare the morphological concepts of European and North American taxa. In some groups of agarics, e.g. in *Armillaria*, interfertility tests have proved to give useful additional information on the affinity of strains from the two continents (Anderson & al., 1980). However, these techniques cannot be used for Hygrophoraceae since attempts to bring them in pure culture have failed up to now. Also molecular-biological techniques offer promising possibilities to test the genetic affinities between European and North American taxa in the future.

Another aspect of my research was the study of the field ecology of Hygrophoraceae, since the literature on this subject suggested important differences in habitat preference between Europe and North America for many species.

Of course it was impossible to make collections of all indigenous species in New York state in one season. Nevertheless, the number of species collected is considerably higher than the 30 species mentioned by Hesler & Smith (1963) for New York. The results of this study will be published as keys, to descriptions of and critical notes on taxa of various infrageneric categories, viz. *Hygrocybe* (1) subsect. *Squamulosae*, (2) subsect. *Coccineae* and *Puniceae*, (3) sect. *Glutinosae*, (4) subsect. *Ovinae* and sect. *Fornicatae*, all belonging to subgen. *Pseudohygrocybe*, (5) subgen. *Hygrocybe*, (6) subgen. *Cuphophyllus* and (7) the genus *Hygrophorus*. In addition a comparison will be made between the ecology of Hygrophoraceae in Europe and North America.

MATERIAL AND METHODS

Collections were mainly made during excursions in New York State, in particular around Ithaca, and in addition during field trips in Pennsylvania, Massachusetts,

N. Carolina, Tennessee and southern Ontario (Canada). Notes were made on accompanying green plants and soil type. At 130 localities soil samples were taken around sporocarps of the upper 5 cm for soil chemical analyses of pH- CaCl_2 and exchangeable fractions of P, K, Mg and Ca in Morgan's solution.

The collections were described in the laboratory and subsequently dried at 40°C. The exsiccata are preserved at the Biological Station at Wijster, the Netherlands (WBS). Duplicates of representative collections are deposited in the Plant Pathological Herbarium at Cornell University (CUP) as indicated under the

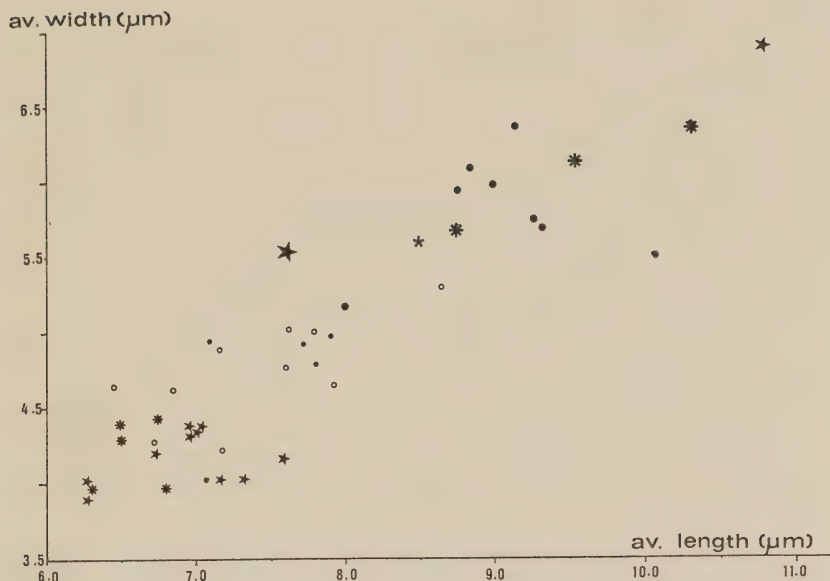


Fig. 1. Scatter diagram of average length and width of basidiospores in North American collections of taxa in *Hygrocybe* subsect. *Squamulosae* (at least 10 spores measured per collection):

● *Hygrocybe cantharellus*; * *H. coccineocrenata*; ★ *H. caespitosa*; ★ *H. turunda* var. *sphagnophila*; ★ *H. reidii*; * *H. squamulosa*; ★ *H. calciphila*; ○ *H. miniata* var. *miniata*; ● *H. miniata* var. *mollis*.

descriptions. Most microscopic characters were studied in exsiccata in the period 1987-1992, but occasionally the structures of pilei- and stipitipellis were investigated in fresh condition. Nuclei in spores of fresh or recently dried sporocarps were counted under a fluorescence microscope after staining with DAPI. In addition, collections of some critical species, including type collections, were borrowed from various herbaria.

The descriptions of this revision are exclusively based on the North American collections quoted under "Collections described". In addition some representative European collections, previously studied by me and considered as identical with North American taxa, are quoted when available under the heading "Other collections studied".

The descriptive terminology and abbreviations of books and journals are according to Bas & al. (1988). Colour codes are according to Kornerup & Wanscher (1978).

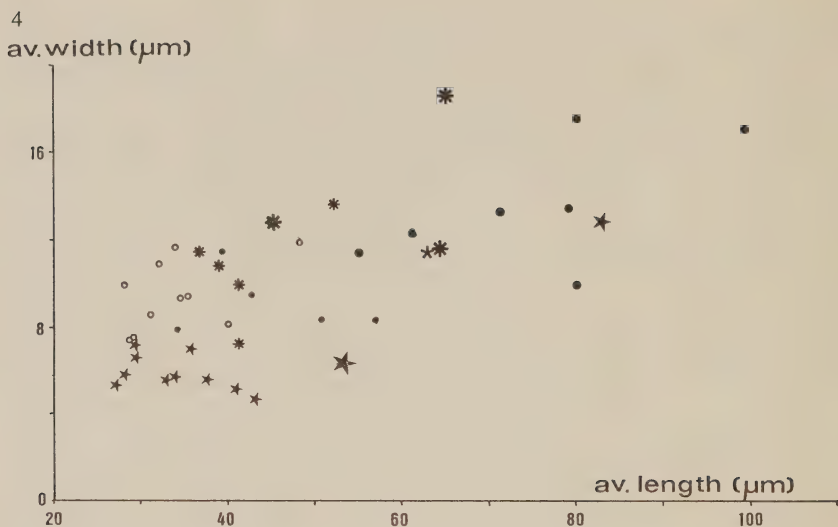


Fig. 2. Scatter diagram of average length and width of terminal elements of pileipellis in North American collections of taxa in *Hygrocybe* subsect. *Squamulosae* (at least 7 elements measured per collection):

● *Hygrocybe cantharellus*; * *H. coccineocrenata*; ★ *H. caespitosa*; ★ *H. turunda* var. *sphagnophila*; ★ *H. reidii*; * *H. squamulosa*; ★ *H. calciphila*; ○ *H. miniata* var. *miniata*; ● *H. miniata* var. *mollis*.

GENERIC AND INTRAGENERIC CLASSIFICATION.

The generic and infrageneric classification are according to Arnolds (1990a,b). The *Hygrophoraceae* are in fact not longer considered as a family, but divided over two tribus of the *Tricholomataceae*: tribus *Hygrocybeae* with the genera *Hygrocybe*, *Camarophylloopsis* and *Dermoloma*, and tribus *Hygrophoreae* with the genus *Hygrophorus*. Only for sake of convenience is the family name maintained in the title of this paper.

The adopted infrageneric classification of *Hygrocybe* is outlined in the following key:

Key to the subgenera, sections and subsections of *Hygrocybe*:

- 1a. Hymenophoral trama irregular, made up of strongly interwoven hyphae with short elements (up to 150 μm). Lamellae decurrent. 2
- b. Hymenophoral trama subregular to regular, made up of subparallel to strictly parallel hyphae with short or long elements. Lamellae free, adnate or decurrent. 3

- 2a. Basidiocarps clitocyboid, relatively stout; pileus (15-)20-100 mm, stipe 2-10 mm thick. Basidiocarps with dull colours: white, brown, violaceous, grey, orangish brown Subgenus *Cuphophyllus*
- b. Basidiocarps omphalinoid; pileus up to 25 mm broad, stipe up to 3 mm thick. At least part of the basidiocarp vividly yellow or orange. Subgenus *Oreocybe*
- 3a. Hymenophoral trama strictly regular, made up of very long tubuliform elements, tapering to the ends, 300-2500x10-35 μ m. Context easily splitting radially in pileus and lengthwise in stipe. Lamellae free or narrowly adnate. Subgenus *Hygrocybe* 4
- b. Hymenophoral trama subregular, made up of long chains of short to medium-sized elements with rounded ends, 30-200(-400)x4-35 μ m (in a few species up to 700 μ m long, but than lamellae broadly adnate). Context firm or brittle, not easily splitting. Lamellae variably attached. Subgenus *Pseudohygrocybe* 6
- 4a. Pileus first hemispherical to obtusely conical, then plano-convex to applanate, occasionally with weak umbo, viscid or glutinous; pileipellis an ixocutis to ixotrichoderm, 80-500 μ m thick. Lamellae narrowly adnate or emarginate. Basidia narrowly clavate, Q=3.5-6. Sect. *Chlorophanae*
- b. Pileus conical or campanulate, then conico-convex with umbo, dry or viscid; pileipellis a cutis or ixocutis up to 100(-200) μ m thick. Lamellae (almost) free. Basidia relatively broadly clavate, Q=2-4.5(-5). Sect. *Hygrocybe* 5
- 5a. Basidiocarps blackening when bruised. Subsect. *Hygrocybe*
- b. Basidiocarps not blackening when bruised, occasionally pale grey at base of stipe. Subsect. *Macrospora*
- 6a. Pileus and stipe viscid to glutinous Sect. *Glutinosae* 7
- b. Pileus dry or viscid; stipe dry 8
- 7a. Pileus and stipe strongly glutinous; pileipellis and stipitipellis an ixotrichoderm. Basidiocarps not vividly coloured: greenish, flesh-coloured, greyish, reddish or orangish brown. Subsect. *Psittacinae*
- b. Pileus and stipe viscid to almost glutinous; pileipellis and stipitipellis an ixocutis to ixotrichoderm. Basidiocarps vividly coloured: yellow, orange or red. Subsect. *Insipidae*
- 8a. Pileus whitish to grey-brown, smooth. Lamellae emarginate. Stipe whitish, faintly striate. Sect. *Fornicatae*
- b. Pileus usually vividly coloured: yellow, orange or red, sometimes greyish or brownish and then lamellae broadly adnate, pileus at centre tomentose to squamulose and stipe smooth. Sect. *Coccineae* 9
- 9a. Pileus smooth; pileipellis a cutis or ixocutis. 10
- b. Pileus at least at centre tomentose to squamulose; pileipellis at centre a trichoderm, to the margin with trichodermial tufts. 11
- 10a. Lamellae narrowly adnate or emarginate. Basidiocarps always stout; pileus over 40 mm broad, stipe 6-20 mm thick, often fibrillose-striate. Subsect. *Puniceae*

- b. Lamellae broadly adnate. Basidiocarps often much smaller. Subject. *Coccineae*
- 11a. Basidiocarps yellow, orange or red, occasionally at pileus with brownish or greyish squamules. Subject. *Squamulosae*
- b. Basidiocarps greyish or brownish. Subject. *Oviniae*

HYGROCYPHE SUBSECT. SQUAMULOSAE (Bataille) Sing.

Hymenophoral trama subregular. Sporocarps with bright yellow, orange or red colours. Pileus surface dry, rugulose to distinctly squamulose; pileipellis at least at centre a trichoderm; stipe dry; stipitipellis a cutis.

Type species: *Hygrocybe turunda* (Fr.:Fr.) P.Karst.

Key to studied taxa of Subject. *Squamulosae* in the northeastern U.S.A.

- 1a. Lamellae short to deeply decurrent, whitish or pale yellow. Spores on the average $8.0-10.3 \times 5.2-6.3 \mu\text{m}$. Terminal cells of pileipellis $35-170 \times 7-25 \mu\text{m}$, on the average broader than $11 \mu\text{m}$. Elements in stipititrama often over $100 \mu\text{m}$ long. 2
- b. Lamellae broadly adnate to emarginate, sometimes with decurrent tooth, usually distinctly coloured: yellow, orange or reddish. Spores on the average $6.2-7.9(-8.7) \times 3.9-5.0(-5.3) \mu\text{m}$. Terminal cells of pileipellis $20-100 \times (3-)4-14(-17) \mu\text{m}$, on the average less than $12 \mu\text{m}$ wide. Elements in stipititrama short, on the average less than $80 \mu\text{m}$ long. 5
- 2a. Elements in stipititrama long, cylindrical, on the average $120-190 \mu\text{m}$, many over $150 \mu\text{m}$ long. 3
- b. Elements in stipititrama short, ellipsoid to cylindrical, on the average under $90 \mu\text{m}$, rarely over $120 \mu\text{m}$ long. 4
- 3a. Scales concolorous with the red to orange-yellow pileus, without grey or brown pigment under the microscope (except in very old sporocarps). Sporocarps usually on decaying wood or soil in forests. 1. *H. cantharellus*
- b. Scales becoming pale greyish brown to blackish on reddish or orange background, with grey or brown pigment in part of the cells under the microscope. Sporocarps usually among *Sphagnum* in bogs. 2. *H. coccineocrenata*
- 4a. Pileus yellowish with brown to black squamules. Spores $7.5-10 \times 5-6.5 \mu\text{m}$. On soil in forests or grasslands. 3. *H. caespitosa*
- b. Pileus first scarlet to orange-red with scales turning gradually pale brown. Spores $10-14 \times 5-9 \mu\text{m}$. Usually among *Sphagnum* in bogs. 4. *H. turunda* var. *sphagnophila*,
see remarks on *H. coccineocrenata*
- 5a. Smell, at least after a while, unpleasant, sweetish, like some kinds of honey.

- Pileus appearing almost smooth, on drying tomentose, rugulose to scurfy at centre. Pileipellis a trichoderm with narrow, cylindrical terminal elements, (3-)4-8 μ m wide. Spores 5.5-8.5(-9.5)x3.5-5.0 μ m, not broadened in frontal view, binucleate. 5. *H. reidii*
- b. Smell not remarkable. Pileus often more distinctly scaly. Pileipellis a trichoderm with broader terminal cells, (5-)6-17 μ m wide. Spores often in part broadened to the apiculus in frontal view, in part constricted: obovoid to pyriform, uninucleate or binucleate. 6
- 6a. Basidiocarps relatively robust: pileus 25-60 mm wide, stipe 4-9(-12) mm thick. Spores binucleate. 6. *H. squamulosa*
- b. Basidiocarps smaller: pileus 10-30(-40) mm wide, stipe 2-5(-6) mm thick. Spores uninucleate or binucleate. 7
- 7a. Spores 6.5-8.5x5.0-6.0(-7.0) μ m, (broadly) ellipsoid, not broadened to the base nor constricted in frontal view, binucleate. 7. *H. calciphila*
- b. Spores 6.0-9.0x4.0-5.5 μ m, ellipsoid to ellipsoid-oblong in side-view, a large proportion broadened to the apiculus in face-view, often constricted (obovoid to obpyriform), uninucleate. 8
- 8a. Pileus scarlet to orange-red at first, gradually fading to orange-yellow or yellow. Lamellae first with orange or pinkish tones. 8. *H. miniata* var. *miniata*
- b. Pileus orange-yellow to yellow from the beginning. Lamellae pale to vividly yellow. 9. *H. miniata* var. *mollis*

Hygrocybe cantharellus (Schw.:Fr.) Murrill, Mycologia 3:196.1911 (as *Hydrocybe*). — Figs. 3-5.

Agaricus cantharellus Schw., Schr. Nat. Ges. Leipzig 1:88.1822; *Agaricus cantharellus* Schw.:Fr., Syst.Mycol.(index:11):1832; *Hygrophorus cantharellus* (Schw.:Fr.) Fr., Epicr.:329.1838; *Camarophyllus cantharellus* (Schw.:Fr.) Murrill, North Amer. Flora 9:388.1916. — *Hygrophorus turundus* var. *lepidus* Boud., Bull. Soc.mycol.Fr.13: 12.1897. — *Hygrocybe lepida* Arnolds, Persoonia 13:139.1986.

SEL.ICON.— Boud., Bull.Soc.mycol.Fr.13:pl.1,fig.2.1897 (as *H. turundus* var. *lepidus*); J.Lange, Fl.agar.dan.5:pl.167B.1940; Romagn., Nouv.Atl.Champ. 4: pl.265B. 1967; Homola & al., Ectomycorrhizae Maine 3:16, fig.30.1985; Lincoff, Field Guide North Amer. Mushr. 2nd ed.:pl.56.1984.

SEL.DESCR. — Arnolds in Bas & al., Fl.agar.neerl.2:98, fig.78.1990; Bird & Grund, Proc.N.S.Inst.Sci.29:115-116,figs.103,104.1979; Hesler & Smith, N.Amer.Spec. Hygrophorus:153-155, fig.42.1963; Kühner, Bull.trimest.Soc. mycol.Fr.92:482.1976; Largent, Agaricales California 5, Hygrophoraceae: 55.1985.

Pileus 7-30 mm, hemispherical to convex, then plano-convex to flattened with depressed centre, usually with crenulate margin, hygrophanous, when moist first scarlet to orange-red (K&W 8A8, 8B8, 9A8), rarely blood-red ((11B8) or egg-yellow (4B8), gradually fading to orange or orange-yellow (7A8, 6A8, 5A8), not

striate or translucently striate up to 1/3 of the radius, drying pale orange-yellow, dry, slightly rugulose or scurfy at centre to distinctly adpressed squamulose all over (sometimes this variation within one collection), scales concolorous with background or slightly paler. Lamellae, $L=15-25$, $l=1-3(-5)$, weakly to strongly arcuate decurrent, subdistant to very distant, thick, often intervened, not ventricose, pale yellow or cream-colour, to the base sometimes pale orange. Stipe $18-67 \times 1.8-4$ mm, cylindrical, narrowly fistulose, concolorous with pileus, base yellow to white, smooth, dry. Context rather firm, in pileus up to 2.5 mm thick, concolorous with surface, inside more spongy, pale yellow to pale orange. Smell and taste mild, not distinctive.

Spores $7.0-12.0(-14.0) \times 4.5-6.5(-7.0) \mu\text{m}$, av. $8.0-10.1 \times 5.2-6.0 \mu\text{m}$, $Q=1.4-1.8$ (2.1), $Q_{\text{av.}}=1.45-1.65(-1.8)$, ellipsoid(-oblong) to ovoid(-oblong), sometimes in part subcylindrical, sometimes a minor part constricted, binucleate. Basidia $35-54 \times 7.5-9.5 \mu\text{m}$, $Q=4.3-6.5$, slenderly clavate, 4-(3-)spored or sometimes 4- and 2-spored intermixed. Edge of lamellae fertile; cheilocystidia absent.

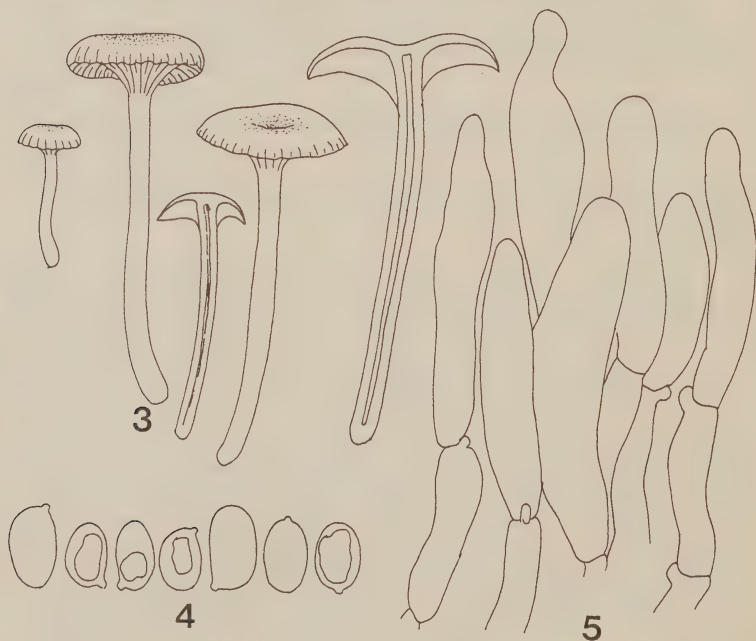


Fig. 3-5. *Hygrocybe cantharellus*. — 3: Sporocarps, $\times 1$. — 4: Basidiospores, $\times 1000$. — 5: Radial section of pileipellis at centre of pileus, $\times 500$ (all from Arnolds 5739).

Hymenophoral trama subregular, made up of rather short, cylindrical to inflated elements, 35-110x5-26 μ m. Pileipellis at centre a trichoderm, to the margin a dry cutis with trichodermial tufts of ascending to erect hyphae with free ends, constricted at septa; terminal elements cylindrical to fusiform, (30-)40-160x7-22 μ m, with orange intracellular pigment when fresh. Pileitrama subirregular with elements 35-70x7-25 μ m. Stipitipellis a thin, poorly differentiated cutis of cylindrical, repent hyphae, 2-6 μ m wide. Stipititrama regular, made up of rather long, cylindrical or slightly inflated elements, (40-)60-200(-330)x6.5-24 μ m, on the average 126-189 μ m long. Clamp connections present in subhymenium and trama.

HABITAT & DISTR. — Solitary or gregarious on moist to mesic, sandy, loamy or peaty soils and on very decayed stumps and logs in deciduous and mixed forests, often along trails. Common in the N.E. States. July-September.

COLLECTIONS DESCRIBED: U.S.A.: MASSACHUSETTS: North Adams, alt. 500m, 16 Aug.1986, Arnolds 5735 (WBS); Amherst, "Mt. Toby State Forest", 11 Aug.1986, Arnolds 5722 (WBS). — NEW YORK: Tompkins Co., "Ringwood", alt. 500m, 17 July 1986, Arnolds 5651 (WBS, CUP); Idem, Arnolds 5653 (WBS); Tompkins Co., Danby, alt. 400m, 23 July 1986, Arnolds 5667 (WBS); Schuyler Co., "Arnot Forest", alt. 520m, 4 Aug.1986, Arnolds 5704 (WBS); Tompkins Co., "Buttermilk Falls State Park", 19 Aug.1986, Arnolds 5739 (WBS, CUP). — PENNSYLVANIA: McCean Co., "Lantz Cors.", 1 Sept.1986, Arnolds 5759 (WBS).

OTHER COLLECTIONS STUDIED: GERMANY: Wilsede, 12 Oct.1968, B. de Vries 77 (WBS). — THE NETHERLANDS: Hilvarenbeek, 24 Sept.1980, Arnolds 4227 (WBS); Staphorst, 18 Oct.1988, Arnolds 5978 (WBS).

NOTES: In general, *H. cantharellus* is distinguished from *H. miniata*, among other things, by larger spores. However, in collection Arnolds 5704 the average spore size is 8.0x5.2 μ m, only slightly larger than most collections of *H. miniata* (Fig. 1).

Collection Arnolds 5735 differs from all other observed collections in an initially deep blood-red pileus and stipe (K&W 11B8). However, microscopical characters are identical with *H. cantharellus*.

H. cantharellus was considered by Rald (1986:11) as a synonym of *H. turunda* (Fr.:Fr.) P. Karst., but this species is in general characterized by darker scales on the pileus and a different ecology, viz. in bogs among *Sphagnum*. However, *H. cantharellus* is occasionally also found in bogs and scales in *H. turunda* may be almost concolorous with the pileus. In that case usually brown pigment is visible in the terminal cells of the pileipellis under the microscope. In a very few cases intermediates are found which are difficult to identify.

Arnolds (1986:139) rejected the name *Agaricus cantharellus* as a nomen dubium and proposed the new name *Hygrocybe lepida*, because *A. cantharellus* was originally described by Schweintz (1822:88) as growing gregarious on rotting wood ("Gregarie crescit in truncis putredine consumtis et in terra lignosa frequens"). The species was never observed on this substrate in Europe and also never gregarious. However, it appeared to be common in the northeastern

U.S.A. on old stumps and logs (also Lincoff, 1984), whereas not a single morphological difference seemed to exist. Consequently *H. lepida* is now regarded as a synonym of *H. cantharellus* in spite of ecological differences between European and North American populations.

In North America *H. cantharellus* seems to be almost confined to the eastern states (Lincoff, 1981). Hesler & Smith (1963:155) reported some collections from Washington and Largent (1985:55) described a few collections from California.

Hygrocybe coccineocrenata (P.D. Orton) Mos., Röhrlinge-Blätterpilze, 3. Aufl.:68.1967. — Figs. 6-10.

Hygrophorus coccineocrenatus P.D. Orton, Trans.Br.mycol.Soc.43:262.1960.

MISAPPL. — *Hygrophorus turundus* sensu auct. p.p.; *Hygrocybe turunda* sensu auct. p.p.

SEL.ICON. — Cetto, Gr.Pilzf., 1. Aufl., 4:pl.1541.1984; Dähncke & Dähncke, 1200 Pilze: 174.1993; J.Lange, Fl.agar.dan.5:pl.168H.1940 (as *H. turunda*).

SEL.DESCR. — Arnolds in Bas & al., Fl.agar.neerl.2:97,fig.76.1990; Kühner, Bull.trimest.Soc.mycol.Tr.92:493-494.1976; P.D. Orton, Trans.Br.mycol.Soc.43: 262.1960.

Pileus 8-23 mm broad, first convex, soon plano-convex to applanate with depressed centre, hygrophanous, colours variable already when young from orange-red (K&W 8A8) to yellow-orange (5A8) or cadmium yellow (4A8), occasionally with greenish tone (4B6, 4B8), minutely squamulose, scales first concolorous with background, later remaining so or mostly turning pale greyish brown to rather dark brown (7E7), margin crenulate, translucent-striate up to 3/4 of the radius when moist. Lamellae, L=14-21, l=1-3, short to deeply decurrent, rather thick, subdistant to distant, pale yellow (2A3, 4; 3A3,4) without orange or reddish tinge. Stipe 28-76x1.5-3.5mm, subcylindrical, usually slender, first orange-red, downwards orange, gradually fading to orange-yellow or cadmium-yellow, dry. Context thin, concolorous. Smell and taste not distinctive.

Spores (7.5-)8.0-11.0(-12.0)x(5.0-)5.5-7.0(-7.5) μ m Q=(1.3-)1.4-1.7(-1.8), av.8.8-10.3x5.7-6.3 μ m, Qav.=1.55-1.65, ellipsoid to ellipsoid- or obovoid-oblong, not constricted, not broader in frontal view in European collections binucleate (American collections not tested). Basidia 35-52x8-11 μ m, Q=3.7-5.8, 4-spored, slenderly clavate. Hymenial cystidia absent. Hymenophoral trama subregular, made up of short, cylindrical to inflated cells, 46-90x5-30 μ m. Pileipellis at centre a trichoderm, to the margin a dry cutis with trichodermal tufts, made up of ascending and erect hyphae with many free ends, constricted at the septa, terminal elements (21-)36-95x(8-)10-20 μ m, often tapering to the apex, with ochre-yellow to brown intracellular pigment. Pileitrama subregular to rather irregular; hyphae 10-22 μ m wide. Stipitipellis a dry, poorly differentiated cutis of repent hyphae, 3-6 μ m wide. Stipititrama regular, made up of rather long, subcylindric elements with rounded ends, (30-)45-240x(6-)9-22 μ m, on the average 125-135x12-15 μ m.

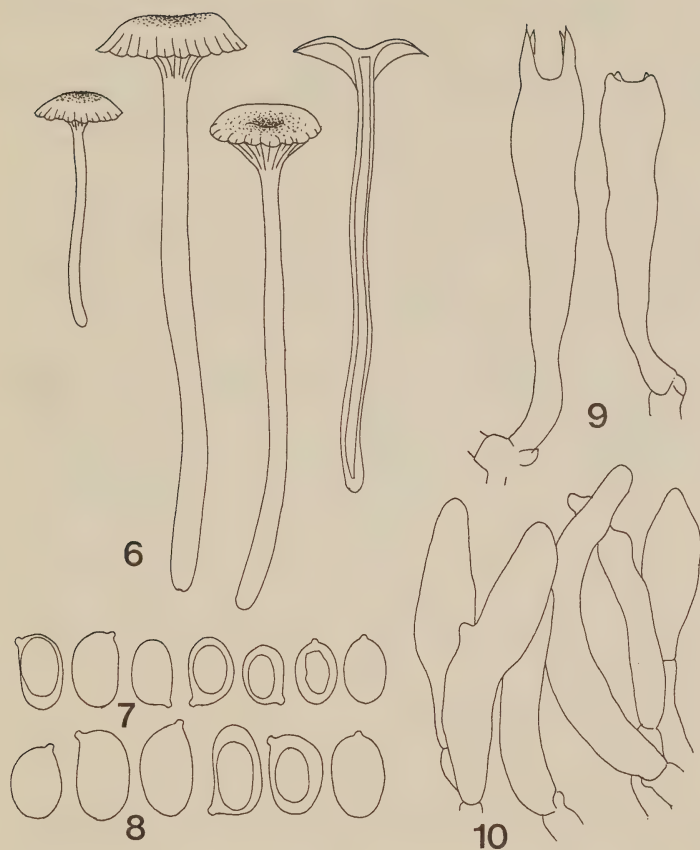


Fig. 6-10. *Hygrocybe coccineocrenata*. — 6: Sporocarps, x1. — 7-8: Basidiospores, x1000. — 9: Basidia, x1000. — 10: Radial section of pileipellis at centre of pileus, x500 (6 from Arnolds 5780; 7, 9 from Arnolds 5779; 8, 10 from Besette 7886).

HABITAT & DISTR. — Solitary or gregarious among *Sphagnum* in oligotrophic to mesotrophic bogs with or without trees (*Betula*), attached to dead parts of *Sphagnum*. Rather rare in the northeastern States, but locally frequent in appropriate habitats. In Europe widespread but local, in similar habitats. July-September.

COLLECTIONS DESCRIBED: U.S.A.: NEW YORK: Adirondack Mountains, Hamilton Co., "Raquette Lake", 6 Sept. 1986, Arnolds 5779 (WBS); Idem, Arnolds 5780 (WBS, CUP); Oneida Co., "Woodgate Bog", 29 Sept. 1988, A. Bessette 7886 (Herb. Bessette; WBS).

OTHER COLLECTIONS STUDIED: THE NETHERLANDS: Nieuwkoop, 31 July 1975, Arnolds 3402 (WBS); Wijster, 8 Aug. 1960, J. Barkman 6625 (WBS); Leimuiden, 28 June 1982, C. Uljé s.n. (WBS).

NOTES: This species belongs to the still insufficiently known complex of *Hygrocybe cantharellus* and *H. turunda*. *H. turunda* sensu lato differs from *H. cantharellus* in the tendency of the scales on the pileus to become brown, but the development of this character is variable, even within one collection. According to Arnolds (1976:156) three interpretations of *H. turunda* exist (see there and under *H. caespitosa*). The collections described above are identical with European collections of a fungus at present generally known as *H. coccineocrenata*. It is characterized by the pale lamellae, habitat in *Sphagnum* and large spores.

Arnolds (1990a) distinguished two varieties: var. *coccineocrenata* with prominent dark brown to black scales, at least in mature sporocarps, and var. *sphagnophila* (Peck) Arnolds with scales which are only slightly greyish. On the basis of this criterion, part of the collections would belong to the latter variety. Therefore I studied the holotype of *Hygrophorus miniatus* var. *sphagnophilus* Peck (Leg. C.H. Peck, July, Kasoog Swamp, NYS). This revealed the following data: Spores 10-11.5(-12.0)x6.5-7.5 μ m, av. 10.8x6.9 μ m, Q=1.57, ellipsoid(-oblong), some slightly phaseoliform, not constricted. Basidia 38-42x9.5-10.5 μ m, Q=3.7-4.5, 4-spored. Hymenial cystidia lacking. Hymenophoral trama subregular, elements 32-92x6-16 μ m. Pileipellis a trichoderm with subcylindrical, clavate or fusiform terminal cells, 56-126x10-15 μ m, often with pale brown intracellular pigment. Stipititrama with rather short elements, 37-125x7.5-17.5 μ m, av. 73.5x12 μ m. Clamp connections frequent.

My observations fit in reasonably well with the type study by Hesler & Smith (1963:146), but I did not find pleuro- and cheilocystidia, described by these authors. The description of these structures by Hesler & Smith, "buried, scattered, versiform" (clavate, fusiform, irregular) suggests the presence of sterile, somewhat miss-shaped basidia (basidiola), which are occasionally found in many species of *Hygrocybe*.

The macroscopic and microscopic characters of *Hygrophorus miniatus* var. *sphagnophilus* agree with *Hygrocybe coccineocrenata* with one exception: the elements in the stipititrama are considerably shorter and this character is regarded as taxonomically important (see also key). Therefore var. *sphagnophilus* is regarded as a different taxon at the moment, but it is certainly not closely related to *H. miniata*, which has, among other things, smaller spores, darker, non-decurrent lamellae and generally a different habitat. *Hygrophorus miniatus* var. *sphagnophilus* is probably identical with *Hygrocybe coccineocrenata* forma *ambigua* described by Kühner (1976:495) from the alpine zone in France. *H. miniatus* var. *sphagnophilus* is in need of another name, but the affinities with related taxa have to be studied more thoroughly first.

Hygrocybe caespitosa Murrill, Mycologia 6:2.1914 (as "Hydrocybe"). — Figs. 11-14.

Hygrophorus caespitosus (Murrill) Murrill, Mycologia 6:2.1914. —
Camarophyllus caespitosus (Murrill) Murrill, North Amer. Fl. 9: 387.1916.

SEL.ICON. — Murrill, Mycologia 6: pl.113, fig.2.1914.

SEL.DESCR.— Hesler & Smith, N.Amer.Spec.Hygrophorus:165-167,
 fig.48. 1963.

For a description of macroscopic characters, see Murrill (l.c.) and Hesler & Smith (l.c.).

Spores $7.5-10.0 \times 5.0-6.5 \mu\text{m}$, av. $8.5 \times 5.6 \mu\text{m}$, $Q=1.4-1.6$, $Q_{\text{av.}}=1.5$, ellipsoid to obovoid, not constricted in any view. Basidia $45-60 \times 7.5-9.5 \mu\text{m}$, $Q=6.0-6.5$, slenderly clavate, 4-(2-)spored. Hymenial cystidia absent. Hymenophoral trama subregular with short, cylindrical to slightly inflated elements, $19-56 \times 4.5-13 \mu\text{m}$. Pileipellis difficult to reinflate, of densely entangled hyphae, at the surface at least in part with erect, broadly clavate terminal elements (apparently a trichoderm), $42-77 \times 8-15 \mu\text{m}$, with yellowish intracellular pigment. Stipitipellis a dry cutis, hyphae $2.5-4 \mu\text{m}$ wide. Stipititrma subregular with elements $59-125 \times 4-11 \mu\text{m}$. Clamp connections present, but probably rare.

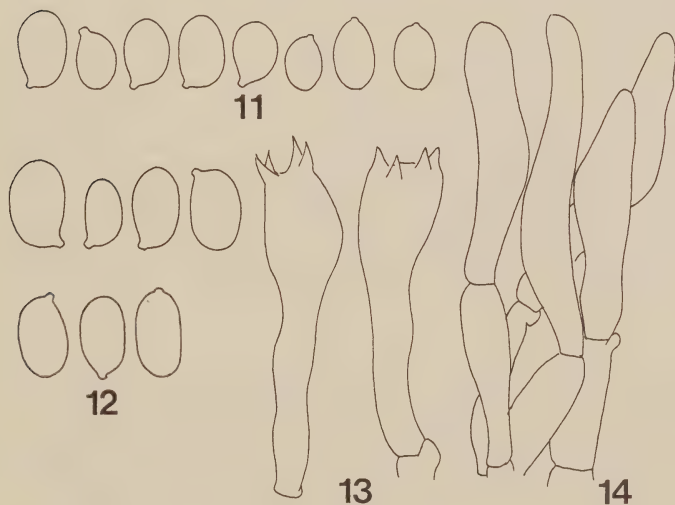


Fig. 11. *Hygrocybe caespitosa*, basidiospores, $\times 1000$ (from Murrill, Aug. 1911, holotype). — Fig. 12-14. *Hygrocybe turunda* var. *sphagnophila*. — 12. Basidiospores $\times 1000$. — 13: Basidia, $\times 1000$. — 14: Radial section of pileipellis at centre of pileus, $\times 500$ (all from Peck, July, holotype).

COLLECTION DESCRIBED: U.S.A., NEW YORK: New York, Bronx, "loosely or densely tufted in open, mossy field", Aug. 1911, Murrill s.n. (HOLOTYPE, NYBG).

NOTES: In macroscopic respect this fungus is characterized by a rather pale to bright yellow pileus with brown scales. This agrees with the original diagnosis of *Agaricus turundus* by Fries (1818, 1821) and with *Hygrocybe turunda* sensu Möller (1945:155), P.D. Orton (1960:270) and sensu Arnolds (1974:174; 1990a:96). The latter taxon has smaller spores ($7-8.5 \times 4.5-5.5 \mu\text{m}$), which are partially broadened and constricted in side-view, as in *H. miniata* (Fig. 30, 31). *H. turunda* sensu Möller, Orton seems to differ from *H. caespitosa* in longer, more elongate spores, $8.5-12 \times 4.5-6 \mu\text{m}$. This group is still insufficiently clear, also because authentic material of *Agaricus turundus* is lacking and a neotype from Fries' collecting grounds is not available. However, *H. caespitosa* might appear to be identical with *Agaricus turundus* in its original sense.

Hygrocybe turunda sensu J. Lange (1940), Kühner & Romagnesi (1953) et al. is a different species, characterized by the initially red pileus with more subtile fuscous squamules, long elements in the stipititrama and habitat in *Sphagnum*. It was named *H. coccineocrenata* by Orton (1960:262), see there.

Hygrophorus turundus sensu Hesler & Smith (1963) might be heterogeneous, possibly comprising both *Hygrocybe turunda* sensu Möller, Orton and *H. coccineocrenata*. For notes on *H. miniatus* var. *sphagnophilus*, see *H. coccineocrenata*.

Hygrocybe reidii Kühner, Bull.trimest.Soc.mycol.Fr.92:463.1976. — Figs.15-20.

MISAPPL.— *Hygrophorus marchii* sensu D. Reid, Fung.rar.Ic.col.3:5.1968; sensu Favre, Champ.sup.Zone Alpine:35.1955.

SEL.ICON.— Boertmann, Svampe 15: fig.3.1987; D.Reid, Fung.rar.Ic.col.3: pl.18a.1968 (as *H. marchii*); Ryman & Holmåsen, Svampar:256.1986.

SEL.DESCR.— Arnolds in Bas & al., Fl.agar.neerl.2:93-94, fig.71.1990; J.Favre, Champ.sup.Zone Alpine:35.1955 (as *H. marchii*); Kühner. Bull.trimest. Soc.mycol.Fr. 92:497-499.1976; D.Reid, Fung.rar.Ic.col.3:5.1968 (as *H. marchii*).

Pileus 10-35(-55) mm broad, first hemispherical, then convex to plano-convex with flattened to slightly depressed centre, finally flattened to slightly depressed, margin often crenulate, hygrophanous, when moist first scarlet to orange-red (K&W 7A8, 8A8, 9B8, 10B8) with narrow yellow-orange margin, gradually fading to orange or orangeish yellow (7A8, 6A8, 5A8m 4A8), not striate or translucently striate up to halfway the radius, drying to dull ochraceous or brownish orange, dry, centre minutely scurfy to tomentose, not squamulose, often appearing smooth when moist, but tomentose covering becoming apparent on drying. Lamellae, L=16-28(-32), l=1-3, broadly adnate with decurrent tooth, up to 5 mm broad, rather thick, distant, pale orange, wax-yellow to pinkish

orange, usually with paler margin. Stipe 25-52(-70)x2-7(-8) mm, cylindrical or tapering downwards, narrowly fistulose, at apex orange, towards the base pale orange, smooth and dry. Context in pileus up to 2.5 mm thick, rather firm, concolorous, inside pale yellow. Smell rather weak but distinctive, unpleasant, sweetish, resembling some kinds of honey, in the field sometimes almost absent but becoming stronger after a few hours in a closed box and on drying.

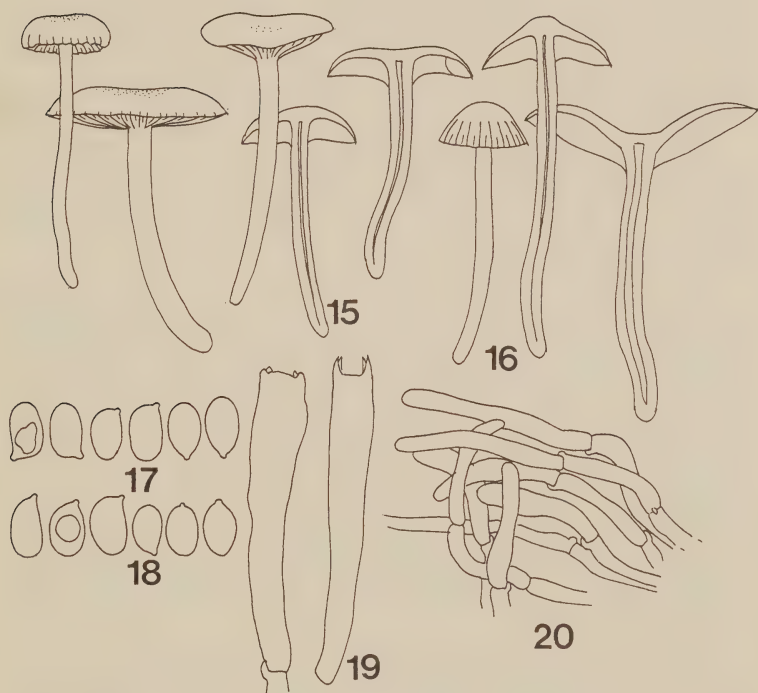


Fig. 15-20. *Hygrocybe reidii*. — 15, 16: Sporocarps, x1. — 17, 18: Basidiospores, x1000. — 19: Basidia, x1000. — 20: Radial section of pileipellis halfway radius of pileus, x500 (15 from Arnolds 5716; 16, 17, 19, 20 from Arnolds 4 Aug. 1988; 18 from Arnolds 5699).

Spores 5.5-8.5(-9.5) $\times$ 3.5-5.0 μ m, av. 6.25-7.6 $\times$ 3.9-4.4 μ m, $Q=1.4-1.9(-2.0)$, $Q_{av.}=1.55-1.8$, ellipsoid(-oblong) to obovoid(-oblong), in some collections a few phaseoliform or weakly constricted (up to 20%), binucleate, rarely some ($\pm 10\%$) uninucleate. Basidia 30-51 $\times$ 5.5-8(-9) μ m, $Q=3.6-7.2$, slenderly clavate, 4-spored, sometimes a minority (up to 25%) 2-spored. Edge of lamellae fertile; cheilocystidia absent. Hymenophoral trama subregular, made up of rather short, subcylindrical to inflated elements, $\pm 18-87 \times 5-21 \mu$ m. Pileipellis at centre a trichoderm of erect, branched, interwoven hyphae with free ends, to the margin a cutis with trichodermial tufts of ascending hyphae with free ends, weakly to strongly constricted at septa, terminal elements subcylindrical to clavate, 19-55(-75) $\times$ (3-)4-8 μ m, with orange intracellular pigment when fresh. Pileitrama subregular to interwoven, hyphae 4-19 μ m wide. Stipitipellis a thin, compact cutis, up to $\pm 20 \mu$ m thick, made up of repent hyphae, 3-5 μ m wide, often with some cylindrical hairs up to 120 μ m long. Stipititrama subregular with short, subcylindrical elements, 30-110 $\times$ 4-17 μ m, on the average less than 80 μ m long. Clamp connections frequent in all tissues.

HABITAT & DISTR. — Solitary or gregarious on moist to dry, acid to basic, loamy soil in deciduous forests (e.g. *Quercus*, *Acer*), once in boggy forest among living *Sphagnum*. Common to very common in the northeastern states of the U.S.A. and adjacent Canada. July-August. In Europe uncommon and mainly in pastures on poor soil, rarely in forests.

COLLECTIONS DESCRIBED: U.S.A.: MASSACHUSETTS: Franklin Co., "Mt. Toby State Forest", 11 Aug. 1986, Arnolds 5716 (WBS). — NEW YORK: Tompkins Co., "Ringwood", alt. 500m, 17 July 1986, Arnolds 5658 (WBS); Tompkins Co., "Danby State Forest", alt. 500m, 24 July 1986, Arnolds 5673 (WBS); idem, alt. 420m, 24 July 1986, Arnolds 5672 (WBS, CUP); Tompkins Co., "Coy Glen", alt. 280m, 28 July 1986, Arnolds 5683 (WBS, CUP); idem, 29 July 1986, Arnolds 5684 (WBS); Schuyler Co., "Arnot Forest", alt. 520m, 4 Aug. 1986, Arnolds 5699 (WBS); Cortland Co., "McLean Bog", alt. 350m, 7 Aug. 1986, Arnolds 5715 (WBS). — RHODE ISLAND: Voluntown, "Pachaug State Forest", 4 Aug. 1988, Arnolds s.n. (WBS).

OTHER COLLECTIONS STUDIED: THE NETHERLANDS: Stadskanaal, 21 Oct. 1978, Arnolds 4060 (WBS); SWEDEN: Medelpad, Torp, 5 Sept. 1987, Arnolds 5898 (WBS).

NOTES: *Hygrocybe reidii* can be easily mistaken in the field for *H. miniata*, although the pileus is less distinctly squamulose and the sweetish smell is very characteristic. The binucleate spores and thin hyphae in the pileipellis are other distinctive characters. In general the spores are smaller than in *H. miniata*, but some overlap occurs (Fig. 1). On the other hand it can be confused with non-squamulose species of subsect. *Coccineae*, in particular *H. marchii*. However, these species lack a distinct trichodermial structure of the pileipellis and are also without a distinctive smell. In fact, the structure of the pileipellis is intermediate between the subsections *Coccineae*, where it was placed by Arnolds (1990a) and *Squamulosae*, where it was inserted by Bon (1990). In my opinion no decisive

arguments can be given for one or the other choice.

One other collection (Arnolds 5647, 17 July 1986, Tompkins Co., Ringwood, WBS) fits in rather well with *H. reidii*, but differs in the absence of the characteristic smell (which, however, can be very weak) and the slightly larger spores (on the average $7.9 \times 4.65 \mu\text{m}$) which, above all, appeared to be intermixed binucleate (55%) and uninucleate (45%).

H. reidii was not recorded before from North-America, although it proved to be common in the northeastern United States. Apparently it has been overlooked and included in other species, in particular *H. miniata*.

Hygrocybe squamulosa (Ell. & Ev.) Arnolds **nov. comb.** — Figs. 21-25.
Basionym: *Hygrophorus squamulosus* Ell. & Ev., Phil. Acad. Sci. Proc. 1893:440. 1894.

Camarophyllus squamulosus (Ellis & Ev.) Murrill, North Amer. Flora 9:388. 1916. — *Hygrophorus miniatus* var. *firmus* Smith & Hesl., Lloydia 5:27. 1942.

SEL. DESCR. — Hesler & Smith, N. Amer. Spec. Hygrophorus: 160-162, fig. 45. 1963; A. H. Smith, Pap. Mich. Acad. Sci. Arts & Letters 20:177, pl. 32. 1935.

Pileus 20-55(-60) mm broad, hemispherical to convex with involute margin, then plano-convex to flattened, centre usually depressed but sometimes umbonate,

hygrophanous, when moist first bright scarlet to orange-red (K&W 8A8, 9A8, 10A8, 10B8) with narrow orange-yellow margin, slowly discolouring to orange or orange-yellow in age, not or short translucently striate (up to 5 mm), drying dull yellowish

or pinkish orange, distinctly adpressed squamulose except smooth margin.

Lamellae, L=21-43, l=3-7(-12), broadly adnate, often with decurrent tooth, up to 8 mm broad, thick, weakly to strongly interveined, subdistant to distant, pale orange, orange-pink to carmin pink (e.g. 6A5,6; 7A6,7; 8A6,7). Stipe 28-80x4-11(-15) mm, cylindrical or slightly ventricose, sometimes compressed, fistulose, orange-red to orange, base white to pale yellow, dry and smooth. Context rather firm, in pileus up to 3 mm thick, concolorous with surface, inside pileus and stipe pale yellow. Smell not remarkable or faintly fruity; taste mild.

Spores (5.5-)6.0-8.0x3.5-5.0 μm , av. $6.3-6.8 \times 4.0-4.4 \mu\text{m}$, $Q=1.4-1.9(-2.0)$, $Q_{av}=1.45-1.7$, in side-view ellipsoid(-oblong) to obovoid(-oblong), not or very few constricted, in front view similar or usually slightly broadened towards base, often (up to 50%) constricted, obovoid to obpyriform, predominantly binucleate, up to 10% uninucleate. Basidia (28-)34-45x6.5-8.5 μm , $Q=4.1-6.7$, slenderly clavate, 4-spored. Basidiola occasionally present, subcylindrical. Edge of lamellae fertile or with scattered cheilocystidia, 25-44x2.5-3.5 μm , subcylindrical, similar to basidiola. Hymenophoral trama subregular, made up of short, cylindrical to weakly inflated elements, 17-87x4-17 μm . Pileipellis at centre a trichoderm, towards the margin a cutis of repent hyphae with many trichodermial tufts of ascending hyphae with free ends, constricted at septa, terminal elements

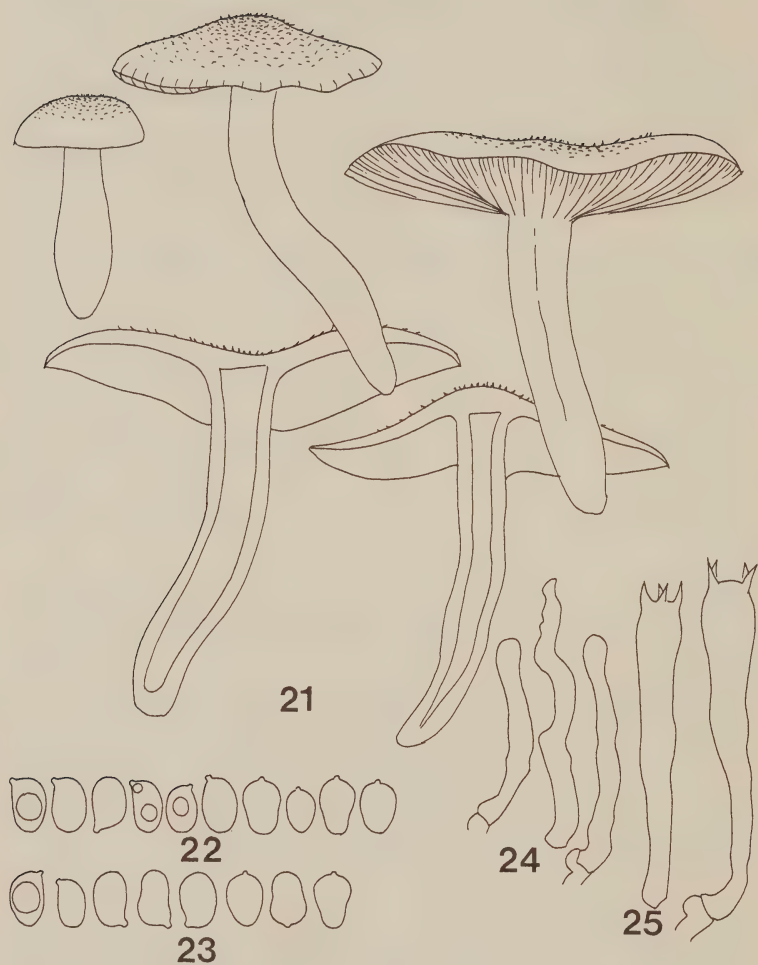


Fig. 21-25. *Hygrocybe squamulosa*. — 21: Sporocarps, x1. — 22-23: Basidiospores, x1000. — 24: Basidia, x1000. — 25: Cheilocystidia (basidiola), x1000 (21 from Arnolds 5755; 22, 24, 25 from Arnolds 5769; 23 from Arnolds 5766).

subcylindrical to clavate or slightly tapering at apex, (19-)23-79(-103)x(6-)7-14(-17) μ m. Pileitrama subirregular with hyphae $\pm$ 5-26 μ m wide. Stipitipellis a dry cutis of compact, repent hyphae, $\pm$ 2-4 μ m wide, in places with erect cylindrical basis up to 45x2 μ m. Stipititrama subregular with short, subcylindrical elements, 50-80x10-19 μ m. Clamp connections frequent in subhymenium, scattered in trama.

HABITAT & DISTR. — Gregarious on and around very decayed trunks or on very humus-rich soil with fragments of rotten wood, in deciduous forests on loamy soils, usually in old-growth forests. Uncommon in the N.E. States. July-September.

COLLECTIONS DESCRIBED: U.S.A.: MICHIGAN: "Whitmore Lake, Mud Lake bog", 15 Aug. 1929, A.H. Smith s.n. (MICH). — NEW YORK: Cortland Co., "Mc Lean Bog", alt. 350 m, 7 aug. 1986, Arnolds 5708 (WBS) — PENNSYLVANIA: "Allegheny State Forest", 15 km S. of Bradford, 27 Aug. 1986, Arnolds 5755 (WBS, CUP); Mc Kean Co., "Lantz Corners", alt. 700 m, 1 Sept. 1986, Arnolds 5766 (WBS, CUP); Mc Kean Co., "Allegheny State Park, Tally Ho", alt. 510 m, 1 Sept. 1986, Arnolds 5769 (WBS).

NOTES: According to Hesler & Smith (1963:141,162) the main difference between *H. miniata* and *H. squamulosa* should be the presence of scattered cheilocystidia and in addition the more fleshy pileus in the latter. On the basis of the presence of cheilocystidia they identified a collection from the Netherlands (Bas 694,L) as *H. squamulosa*. This collection was, together with many other collections of *H. miniata* sensu lato, studied again by Arnolds (1974, 1986), who concluded that the occurrence of marginal hairs is an occasional phenomenon without taxonomic relevance. For instance, in the collection designated as neotype of *H. miniata* he found one basidiocarp with numerous cheilocystidia and another one where these structures were completely lacking (Arnolds, 1986:147, 154). In view of these observations *H. squamulosa* was considered as conspecific with *H. miniata*.

During my stay in Ithaca I came across a large, thick-stemmed member of the *miniata*-group, which I did not know from Europe. The macroscopic differences with *H. miniata* were supported by the consistently binucleate spores in contrast to predominately uninucleate spores in *H. miniata*. In addition the spores are in general smaller than in *H. miniata*, but some overlap occurs (Fig. 1). This large taxon fits the original description of *Hygrophorus squamulosus* by Ellis & Everhardt (1894) well and this name is therefore accepted.

Hygrocybe squamulosa may very well be an indicator species of old-growth forests in northern America, where it usually grows on or around large, very strongly decayed stumps of trees. It has never been observed in Europe but might occur in some forest reserves.

Hygrocybe calciphila Arnolds, Persoonia 12: 475.1985. — Figs. 26-28.

MISAPPL. — *Hygrophorus miniatus* sensu P.D. Orton, Trans.Br.mycol.Soc. 43:249. 1960.

SEL.DESCR. — Arnolds, Persoonia 13:57.1986; Arnolds in Bas & al., Fl.agar. neerl.2:100, fig.80.1990.

Pileus 27 mm broad, plano-convex with flattened centre and crenulate margin, when moist bright orange with yellow margin, translucently striate up to 1/4 of the radius, dry, faintly fibrillose when dry. Lamellae, L=24, l=1-3, broadly adnate with decurrent tooth, distant, pale orange with broad yellowish margin. Stipe 55x5 mm, slightly tapering downwards, narrowly fistulose, orange-yellow, dry. Context rather fragile, concolorous. Smell and taste not distinctive.

Spores 6.5-8.5x5.0-6.0(-7.0) μ m, av.7.6x5.5 μ m, Q=1.3-1.5(-1.6), Qav.=1.35, ellipsoid to slightly obovoid in all views, not constricted or broadened in frontal view, binucleate. Basidia 37-47x7-8.5 μ m, slenderly clavate, 4-spored. Hymenial cystidia absent. Hymenophoral trama made up of short, cylindrical or slightly inflated elements, up to 80 μ m long. Pileipellis a cutis of rather broad hyphae, constricted at septae, in places with tufts of ascending hyphae with free ends; terminal cells 34-85x5-9 μ m, cylindrical or slightly tapering to the end.

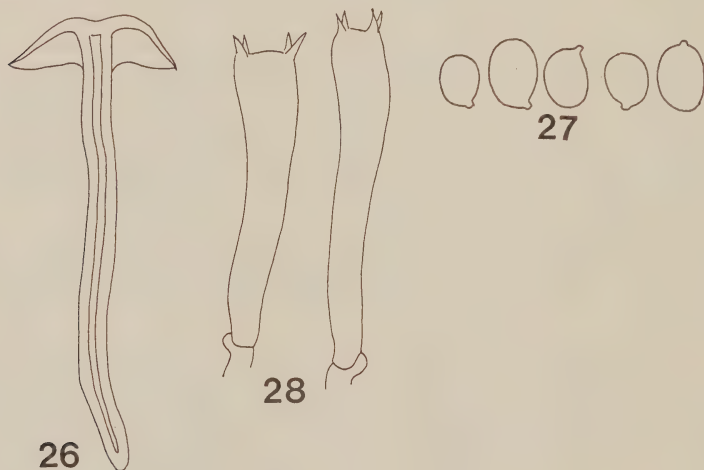


Fig. 26-28. *Hygrocybe calciphila*. — 26: Sporocarps, x1. — 27: Basidiospores, x1000. — 28: Basidia, x1000 (all from Arnolds 5801A).

HABITAT & DISTR. — Among mosses (mainly *Polytrichum commune*) and herbs in abandoned field on compact loamy soil. Only found once in New York. In Europe not uncommon in poor pastures on dry, calcareous, loamy soils.

COLLECTION DESCRIBED: U.S.A., NEW YORK: Cortland Co., "Hoxie Gorge", alt. 370 m, 2 Oct. 1986, Arnolds 5801 A (WBS).

OTHER COLLECTIONS STUDIED: THE NETHERLANDS: Vleuten, 14 Oct. 1976, C. Bas 7101 (holotype, L); Bemelen, 31 Oct. 1980, Arnolds 4481 (WBS).

NOTES: This species is in the field very similar to *H. miniata*, although usually more orange and less distinctly squamulose. It is readily distinguished on the basis of the ellipsoid spores which are not broadened in face-view and have two nuclei. In addition, in Europe *H. calciphila* seems to be restricted to clayey, calcareous soils, whereas *H. miniata* is acidophytic and found on sand, peat and loam. It was not reported from North America before. The American collection, consisting of a single sporocarp, was unfortunately lost by accident after completion of the examination.

Hygrocybe miniata (Fr.:Fr.) Kumm., Führ. Pilzk.:112.1871, var. *miniata*. — Figs. 29-35.

Agaricus miniatus Fr.:Fr., Syst.mycol.1:105.1821; *Hygrophorus miniatus* (Fr.:Fr.) Fr., Epicr.:33.1838. — *Hygrophorus strangulatus* P.D. Orton, Trans.Br.mycol.Soc.43: 266.1960; *Hygrocybe strangulata* (P.D.Orton) Svrcek, Česká Mykol.16:167.1962;

SEL.ICON. — Cetto, Gr.Pilzf., 2.Aufl.,2: pl.674.1979; Dähncke & Dähncke, 700 Pilze: 125.1979; D. Reid, Fung.rar.lc.col.3: pl.18b.1968 (as *H. strangulatus*); Lincoff, Field Guide North Amer. Mushr.: pl.69.1981.

SEL.DESCR. — Arnolds in Bas & al., Fl.agar.neerl.2:99, fig.79.1990; M.Bon, Doc.mycol.7(25):17.1976; P.D.Orton, Trans.Br.mycol.Soc.43:266-267.1960; D.Reid, Fung.rar.lc.col.3:6-8.1968 (as *H. strangulatus*).

Pileus (8-)12-30(-40) mm broad, first hemispherical, sometimes with involute margin, then convex to plano-convex, often with depressed centre, finally flattened to slightly depressed, hygrophanous, when moist first scarlet to orange-red (K&W 8A8, 8B8, 9A8, 9B8, 10B8) with narrow (orange-)yellow margin, gradually fading to orange- or orange-yellow, translucently striate up to 1/4-3/4 of the radius, drying dull yellowish orange, dry, scurfy-squamulose all over or at least at centre, scales concolorous or slightly paler. Lamellae, L=18-35, l=(1-)3(-7), broadly adnate to deeply emarginate, up to 4 mm broad, often ventricose, pale to vividly orange(-yellow) or pinkish orange (e.g. K&W 4A5, 5A4-7, 6A6, 7A6) with concolorous or paler yellow margin. Stipe 18-68x2-5(-6) mm, subcylindrical, narrowly fistulose, concolorous with pileus or slightly paler, extreme base white tomentose. Context rather firm, in pileus up to 2.5 mm thick, concolorous with surface, inside stipe and pileus cream-coloured. Smell not remarkable; taste mild.

Spores (5.5-)6.0-9.0(-9.5)x(3.5-)4.0-5.5(-6.0) μ m, av.6.5-7.7(-8.7)x4.2-5.0(-5.3) μ m Q=1.3-1.8(-2.0), Qav.=1.5-1.7, in side-view ellipsoid(-oblong) to obovoid(-oblong), not constricted, in frontal view often broader (up to 6.0(-7.0) μ m, Q=1.2-1.6), obovoid to obpyriform, in part (30-60%) constricted, uninucleate or a minority (up to 30%) binucleate. Basidia 27-50x6-10 μ m,

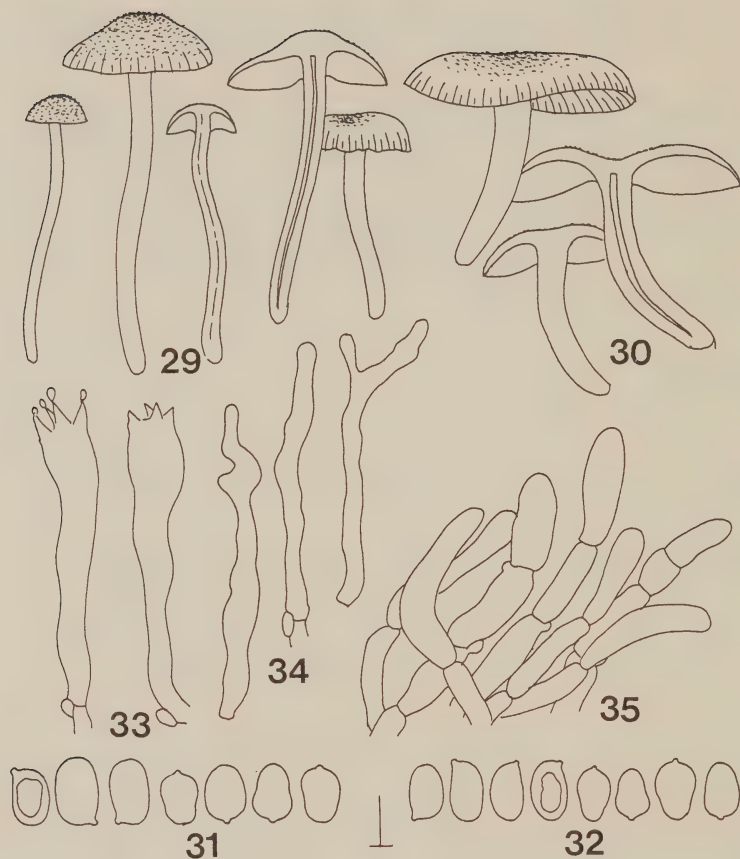


Fig. 29-35. *Hygrocybe miniata* var. *miniata*. — 29-30: Sporocarps, x1. — 31-32: Basidiospores, x1000. — 33: Basidia, x1000. — 34: Cheilocystidia (basidiola), x1000. — 35: Radial section of pileipellis near centre of pileus, x500 (29 from Arnolds 5717; 30 from Arnolds 5740; 31, 33, 34, 35 from Arnolds 5793; 32 from Arnolds 5814).

Q=3.7-6.2, slenderly clavate 4-(2-)spored or 4- and 2-spored intermixed. Edge of lamellae fertile, but in two collections (Arnolds 5784, 5793), with numerous scattered subcylindrical cheilocystidia, 28-55x2.5-5 μ m. Pleurocystidia absent. Hymenophoral trama subregular, made up of subparallel hyphae with short, cylindrical to slightly inflated elements, 20-115x4-17 μ m. Pileipellis at centre a trichoderm of erect hyphae with many free ends, to the margin a dry cutis with tufts of ascending hyphae, constricted at septa, terminal elements ellipsoid, clavate or subcylindrical, 19-60(-80)x6-13(-15) μ m, in fresh condition with orange intracellular pigment. Pileitrama subirregular, made up of short elements, $\pm$ 22-105x5-20 μ m. Stipitipellis a dry compact cutis made up of thin, repent hyphae, $\pm$ 2-5 μ m wide, sometimes with erect cylindrical hairs, projecting up to 40 μ m. Stipititrama subregular, made up of short, subcylindrical elements, 25-110x5-16 μ m. Clamp connections present in all tissues.

HABITAT & DISTR. — Solitary or gregarious on moist to dry, sandy loamy or peaty, acidic soils, on very decayed stumps and bogs of frondose trees, occasionally amongst *Sphagnum*, in various types of young and old deciduous and coniferous forests and in poor pastures. In Europe mainly in poor grasslands and heathlands on acid soils, occasionally in forests on poor soils, not recorded from rotten wood. Very common in northeastern United States and adjacent Canada. August-October.

COLLECTIONS DESCRIBED — U.S.A.: MASSACHUSETTS: Franklin Co., "Mt. Toby State Forest", 11 Aug. 1986, Arnolds 5717 (WBS). — MICHIGAN: Luce Co., "Pike Lake", on *Sphagnum*, 11 Sept. 1953, A.H. Smith 42560 (Holotype of *Hygrophorus miniatus* f. *longipes*, MICH). — NEW YORK: Tompkins Co., "Buttermilk Falls State Park", 19 Aug. 1986, Arnolds 5740 (WBS, CUP); Adirondack Mountains, Franklin Co., "Mount Morris", alt. 660 m, 7 Sept. 1986, Arnolds 5789 (WBS); Schuyler Co., "Connecticut Hill, Lost Gorge", among *Sphagnum*, alt. 400 m, 18 Sept. 1986, Arnolds 5793 (WBS); Broome Co., "Center Lisle", alt. 350 m, 8 Oct. 1986, Arnolds 5814 (WBS, CUP); Idem, Arnolds 5815 (WBS); Idem, Arnolds 5819 (WBS). — PENNSYLVANIA: Wampum, Oct. 1986, E. Johnston s.n. (WBS).

OTHER COLLECTIONS STUDIED: — GREAT BRITAIN: Surrey, Witley Common, 5 Nov. 1958, P.D. Orton 1554 (isotype of *Hygrophorus strangulatus*, E). — THE NETHERLANDS: Terschelling, Oosterend, 3 Nov. 1973, Arnolds 3049 (WBS); Beilen, 12 Oct. 1973, Arnolds 948 (WBS). — SWEDEN: Smoland, Femsjö, 21 Sept. 1980, M. Moser 80/372 (neotype of *Hygrocybe miniata*, IB).

NOTES. Within subsect. Squamulosae, *H. miniata* is characterized by rather small sporocarps with non decurrent lamellae which are distinctly coloured, a pileus with concolorous scales and rather small, uninucleate spores which are often slightly flattened and in frontal view often constricted. It is morphologically similar to European collections and the neotype designated by Arnolds (1976).

The forma *longipes*, distinguished by Smith & Hesler (1954) on the basis of its more slender stipe, distinctly striate, less squamulose pileus, less frequent clamp connections, and habitat in *Sphagnum*, is not distinguished here. I studied

part of the holotype and did not find any microscopic difference with other collections of *H. miniata*. Clamps were frequent under the basidia and scattered elsewhere. The frequency of clamp connections in other tissues is quite variable, even within one collection. Many collections of typical *H. miniata* have a more or less striate pileus and the development of scales is a variable character as well: sometimes only visible at the centre as a somewhat rugulose, tomentose covering, sometimes distinctly scaly all over the pileus except the extreme margin. The length of the stipe is influenced by the environment, as already suggested by Hesler & Smith (1963:156,160).

Poorly differentiated cheilocystidia (in fact basidiola) were observed in two collections (Arnolds 5784, 5793). On the basis of this character they might be identified according to Hesler & Smith (1963) as *H. squamulosa*. However, in my opinion the presence of cheilocystidia is in this case not of taxonomic importance. *H. squamulosa* is distinguished on the basis of a different set of characteristics (see there and key).

One collection (Arnolds 5784) comprises young sporocarps with a pileus colour ranging from orange-red to orange-yellow and is therefore intermediate between var. *miniata* and *mollis* (see there). This collection also deviates from the two varieties in large spores, on the average $8.7 \times 5.3 \mu\text{m}$, more in the range of *H. cantharellus* (Fig. 1). However, all other characters indicate *H. miniata*.

Hygrophorus miniata (Fr.:Fr.) Kumm. var. *mollis* (B.&Br.) Arnolds, Persoonia 13: 148.1986. — Figs. 36-37.

Hygrophorus turundus var. *mollis* B.& Br., Annls Mag.nat.Hist., Ser.IV, 7:434. 1871. (Notic.Br.Fungi 1279); *Hygrophorus mollis* (B.& Br.) C.H. Kauffm., Pap. Mich.Acad.Sci.Arts Letters 5: 130.1926; *Hygrocybe mollis* (B.& Br.) Mos., Röhrlinge-Blätterpilze, 3. Aufl.: 69.1967; *Hygrophorus miniatus* var. *mollis* (B.& Br.) Arnolds, Persoonia 8: 103.1974. — *Hygrocybe moseri* M.Bon, Doc.mycol. 6(24):42. 1976; *Hygrocybe miniata* f. *moseri* (M.Bon) M.Bon, Fl.mycol.Europe 1, Hygrophores: 54.1990.

EXCL. — *Hygrocybe mollis* sensu Mos., Z.Pilzk.33:9.1967 (= *H. helobia*); sensu Kühner, Bull.trimest.Soc.mycol.Fr.92:489.1976(= *H. spec.*).

SEL.ICON. — M. Bon, Fl.mycol.Europe 1, Hygrophores: pl.3G.1990; Cooke, Ill.Brit.Fungi 6:pl.910B (921).1888 (mediocre); Galli, Igrofori nostre Reg.: 47.1985 (excl. spore size).

SEL.DESCR. — Arnolds in Bas & al., Fl.agar.neerl.2:99-100.1990; M. Bon, Doc.mycol. 7(25):17.1976; P.D. Orton in Trans.Br.mycol.Soc.43:249.1960; Largent, Agaricales California 5, Hygrophoraceae: 87.1985.

Pileus 11-32 mm broad, first convex to conico-convex, then plano-convex to flattened, often with depressed centre, hygrophanous, when moist first orange to yellow-orange (K&W 5A8, 6A8) with narrow bright yellow margin, gradually fading to orangeish yellow or yellow, translucently striate up to 1/4 to 2/3 of the radius, drying dull ochre-orange or ochraceous yellow, tomentose-rugulose to distinctly scaly at least at centre, scales concolorous. Lamellae, L=14-22, l=1-

7, broadly adnate to emarginate, with or without decurrent tooth, often slightly ventricose, pale orange-yellow, butter-yellow or pale yellow (3A3, 3A4, 3A5, 4A4, 4A5, 4A6/5A6). Stipe (15-)24-55x2-5 mm, subcylindrical, narrowly fistulose, concolorous with pileus or slightly paler, base often white tomentose. Context rather firm to brittle, in pileus up to 2.5 mm thick, concolorous with surface, inside stipe and pileus softer, yellow or cream-coloured. Smell not remarkable; taste mild.

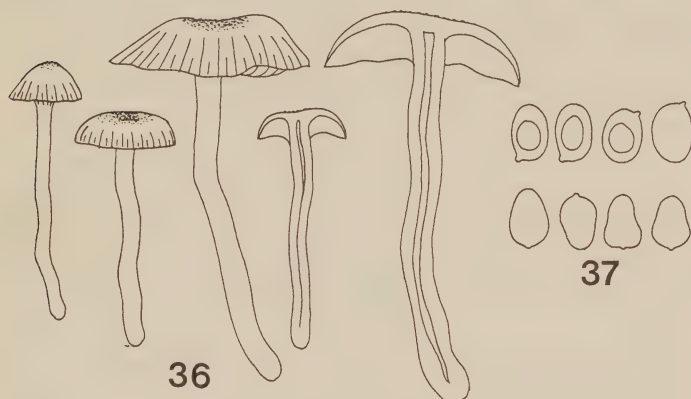


Fig. 36-37. *Hygrocybe miniata* var. *mollis*. — 36 Basidiocarps, x1. — 37: Basidiospores, x1000 (from Arnolds 5778).

Spores (5.5-)6.0-9.0x3.5-5.5 μ m, av. 7.1-7.9x4.0-5.0 μ m, $Q=(1.2-)$ 1.3-1.9, $Q=1.4-1.75$, in side-view ellipsoid(-oblong) to obovoid(-oblong), rarely a few constricted, in frontal view often broadened to the apiculus, in part (up to 40%) constricted, uninucleate or a minority (up to 20%) binucleate. Basidia 31-50x6.5-9.5 μ m, $Q=3.6-6.3$, slenderly clavate, 4-spored or 4-, 2- and 3-spored intermixed. Edge of lamellae fertile, but in one collection (Arnolds 5771) with scattered, subcylindrical, often tortuose cheilocystidia, 29-53x2.5-5 μ m. Pleurocystidia absent. Hymenophoral trama subregular, made up of subparallel hyphae with short, cylindrical to inflated elements, 23-95(-140)x5-21 μ m. Pileipellis at centre a trichoderm of erect hyphae with many free ends, to the margin a dry cutis with tufts of ascending hyphae, constricted at septa, terminal elements 24-92(-100)x(5-)6-12 μ m, in fresh sporocarps with pale orange or yellow intracellular pigment. Pileitrampa subirregular, made up of short elements, 31-160x7-20 μ m. Stipitipellis a dry cutis of repent hyphae, 2-6 μ m wide, with or without scattered to clustered erect hairs up to 50 μ m long. Stipititrampa subregular, made up of parallel hyphae with cylindrical to inflated elements, 22-115x6-20 μ m. Clamp connections present in all tissues.

HABITAT & DISTR. — In similar habitats as var. *miniata*, but not found in pastures in North-America. Less frequent (uncommon) in the northeastern United States and adjacent Canada. August-September. In Europe also with a similar ecology as var. *miniata* and also much less frequent.

COLLECTIONS DESCRIBED. — CANADA: ONTARIO: Bassardand S. Burgess Township, Lake Rideau, "Exe Island", alt. 430 m, 23 Aug. 1986, Arnolds 5867 (WBS, CUP). — U.S.A.: NEW YORK: Schuyler Co., "Arnot Forest", alt. 520 m, 4 Aug. 1986, Arnolds 5707 (WBS); Adirondack Mountains, Hamilton Co., "Raquette Lake", 6 Sept. 1986, Arnolds 5778 (WBS, CUP).

OTHER COLLECTIONS STUDIED. — France: Larronville, Sept. 1963, M. Bon s.n. (holotype of *Hygrocybe moseri*, herb. M. Bon). — THE NETHERLANDS: Vlagtwedde, 21 Oct. 1978, Arnolds 4051 (WBS); Callantsoog, 5 Nov. 1977, Arnolds 3990 (WBS).

NOTES: The only difference with var. *miniata* is the predominance of orange and yellow pigments in the sporocarps from the beginning. In one collection (Arnolds 5784), listed under var. *miniata*, young sporocarps with yellow-orange and red colours were growing side by side. Similar intermediate collections were occasionally found in northwestern Europe. They indicate that a distinction in the rank of species is not allowed and even the distinction as varieties may be questioned.

One collection (Arnolds 5771) had cheilocystidia and might therefore according to Hesler & Smith (1963) key out as *H. squamulosa*. See remarks on that species and var. *miniata*.

A study of the type of *H. moseri* by Arnolds (1986:148-149) revealed that this species is identical with *H. miniata* var. *mollis*. *H. moseri* was reported from California by Largent (1985:88), but his description deviates in the initially red pileus, the decurrent lamellae and spores which are not broader in frontal view.

One collection (Arnolds 5724, Massachusetts, Williamstown, WBS) is in all characters similar to *H. miniata* var. *mollis* except for the predominantly binucleate spores (70%; 30% uninucleate). Since this character is considered to be of great taxonomic importance in *Hygrocybe* (Kühner, 1976), this collection is not listed above and regarded as unidentifiable for the time being.

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POLYCOCCUM EVAE (DOTHIDEALES), A NEW LICHENICOLOUS FUNGUS ON DIMELAENA OREINA

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Abstract: A new species of lichenicolous fungus, *Polycoccum evae* Calatayud & Rico (Dothideales), is described from Spain. It is distinguished from related species by the immersed ascomata, the dark brown spores with a coarsely verruculose epispore and a gelatinous sheath, and by its occurrence on *Dimelaena oreina* (Ach.) Norman.

Key words: Lichenicolous fungi, Spain, Dothideales, *Polycoccum evae*, *Dimelaena oreina*.

During a study on the chemotypes of *Dimelaena oreina* (Ach.) Norman in the Iberian Peninsula (RICO & CALATAYUD, ined.), several lichenicolous fungi were examined. One of the most frequently observed is described below as a new species of *Polycoccum*, the first of this genus observed on *Dimelaena*.

Polycoccum evae Calatayud & Rico, spec. nov.

Fig. 1.

Ascomata perithecia in thallo *Dimelaenae oreinae* immersa, subglobosa, ostiolata, atra, 0,1-0,2 mm diam. Paries brunneus ad basim, atrobrunneus ad ostiolum; centrum cum iodo non reagens. Pseudoparaphyses ramosae et anastomosantes, 1-2 µm crassae. Asci elongatoclavati, bitunicati, membranis in apicis incrassatis, in iodo non caerulescentes, 65-90 x 17-22 µm, (6)8-spori.

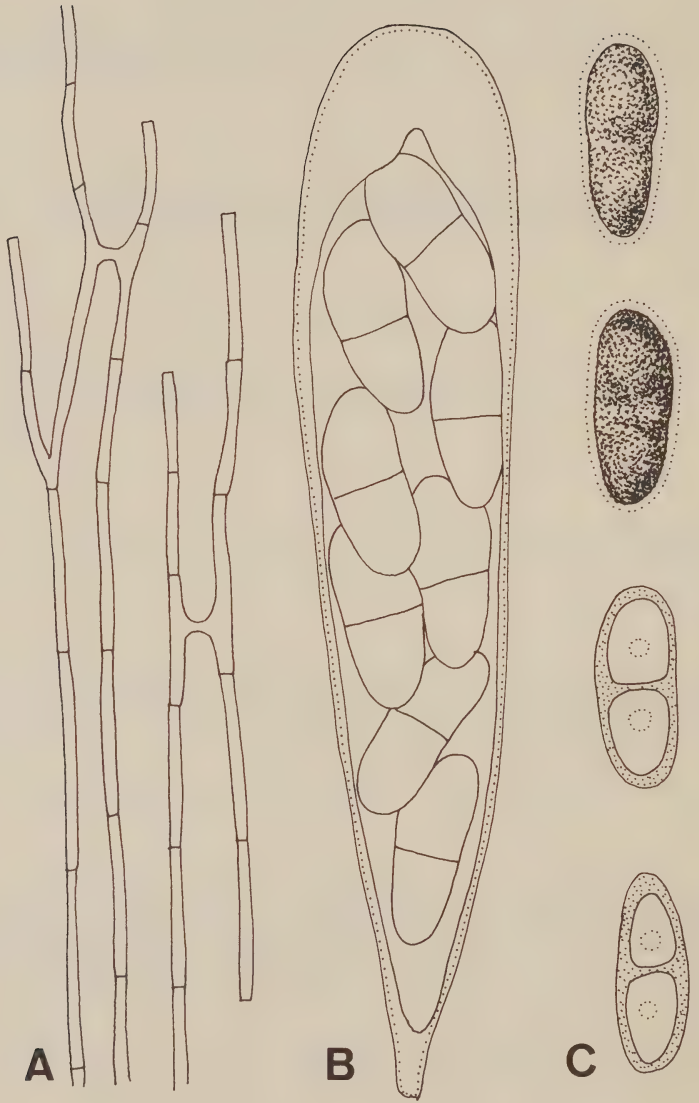


Fig. 1. *Polycoccum evae* (MAF-Lich.4250; holotypus). a) Pseudoparaphyses; b) ascus with ascospores; c) ascospores. Scale bar= 20 µm

Ascosporae ellipsoideae, 1-septatae, brunneae vel atrobrunneae, verruculosae, halonatae, (17)18-23(25) x (6)7-10(11) μm .

Typus: SPAIN, Madrid: Manzanares el Real, La Pedriza (Sierra de Guadarrama), collado de Valdealcones, 1240 m, 30TVL2311, en el talo de *Dimelaena oreina*, granito, 29-V-1986, V.J. Rico & E. Barreno, 593/2Rico (holotypus: MAF-Lich.4250, isotypus: herb. Diederich).

Ascomata perithecioid, immersed in the thallus of *Dimelaena oreina*, with only the ostium visible, subglobose, 0.1-0.2 mm in diameter, arising singly but not scattered, more abundant in some parts of the host thallus, not producing deformations nor discolored or necrotic patches, without visible mycelium on the lichen thallus. Wall of *textura angularis* or, in some parts, similar to *textura epidermoidea*, brown; in the surrounding of the ostium the wall is darker brown and the cells are more elongated. Hamathecium composed of a net of branched and anastomosing filaments, 1-2 μm thick, probably trabeculate pseudoparaphyses (paraphysoids?), very abundant; centrum I-, KI-. Asci elongate-clavate, 65-90 x 17-22 μm , with a conspicuous apical dome penetrated by a narrow ocular chamber, with two functional wall layers (bitunicate), discharge fissitunicate, (6)8-spored; wall and tholus I-, but the content of the asci I+ reddish. Ascospores brown to almost black, ellipsoid, (17)18-23(25) x (6)7-10(11) μm , 1-septate, cells $\pm$ equal in size, apices rounded, normally not constricted at the septum, with a coarsely verruculose epispore and, commonly, with a gelatinous sheath of ca. 2 μm .

Etymology: The species is named in honor of Prof. Eva Barreno (Spain, València).

Observations: *Polycoccum evae* is mainly characterized by the immersed ascomata, the dark brown spores with a coarsely verruculose epispore and a gelatinous sheath, and by its occurrence on *Dimelaena oreina*. As no visible damages in the thallus of *D. oreina* are produced, *P. evae* may be considered a parasymbiotic fungus. It seems to be closely related to *P. tinantii* Diederich, a species hitherto known only from Luxembourg, on *Caloplaca ferruginea* (Huds.) Th.Fr. (DIEDERICH, 1990). In addition to the different host species, *P. evae* differs from *P. tinantii* in having smaller and immersed ascomata and, in particular, by its brown to almost black, coarsely verruculose spores with a gelatinous sheath. *Polycoccum tinantii* has superficial or slight immersed ascomata and the spores are brown, finely verrucose and without a gelatinous sheath. *Polycoccum squamarioides* (Mudd) Arnold, another *Polycoccum* species with similar spore size, is easily separated from *P. evae* by its $\pm$ smooth spore wall, without a gelatinous sheath (HAWKSWORTH & DIEDERICH, 1988) and by occurring on different hosts: *Placopsis*, *Pertusaria* and *Phlyctis* (CLAUZADE, DIEDERICH & ROUX, 1989). *Polycoccum epicrassum* (H. Olivier) R. Sant. has spores of similar size with a verruculose epispore, but is only known growing on *Squamarina cartilaginea* (With.) P. James, the ascomata arise in necrotic patches, and the spores lack the characteristic gelatinous sheath of *P. evae*.

Although in an unpublished study on the chemotypes of *Dimelaena oreina* in the Iberian Peninsula (RICO & CALATAYUD, ined.) four chemotypes have been recognized (I, II, IV and a new one, "VI"; numbers following LEUCKERT & POELT, 1978), all the samples of *P. evae* were collected only on chemotypes IV (usnic and stictic acids as main substances) and "VI" (usnic, stictic and gyrophoric acids as main substances). This apparent host restriction appears to provide further evidence for a close relationship between these two chemotypes, previously proposed on the basis of chemical and phytogeographical evidence (SHEARD, 1977; RICO & CALATAYUD, ined.). But, considering that the chemotypes I and II are infrequent on the Iberian Peninsula and consequently the number of specimens examined is low, only further studies with more material will clarify whether the restriction of *P. evae* to the two reported chemotypes is due to a chemical (and genetic?) selectivity by the lichenicolous fungus.

Distribution: The new species is only known from Spain; all samples were collected in Central Spain (Madrid), except one in Catalonia.

Additional specimens studied (all on *Dimelaena oreina*): SPAIN, MADRID: La Pedriza, umbría del Yelmo, gneis, espolón ornoticoprófilo, 30TVL2612, 1400 m, 21-II-1987, F. Valladares & Gil, FV84 (MAF); *ib.*: San Martín de Valdeiglesias, embalse de San Juan, cerro Almodón, 650 m, 30TUK8273, granito, 2-I-1984, E. Barreno & V.J. Rico, 200Rico (MAF); *ib.*: La Cabrera, Sierra de La Cabrera, pico de El Mojón, 1240 m, 30TVL4623, granito, 27-X-1985, V.J. Rico & M.A. Florido, 435/2Rico (MAF); *ib.*: Collado-Mediano, cerro del Castillo, 1300 m, 30TVL1406, granito, 7-IX-1986, V.J. Rico, 895/1Rico (MAF); *ib.*: entre El Berrueco y Berzosa del Lozoya, embalse de El Villar, 900 m, 30TVL5233, gneis, 16-VII-1985, E. Barreno & V.J. Rico, 275/2 and 277/3Rico (MAF); *ib.*: Manzanares el Real, La Pedriza, arroyo del Chivato, 1480 m, 30TVL2415, granito, 2-VI-1986, V.J. Rico & E. Barreno, 503Rico (MAF); *ib.*, GIRONA: Alt Empordà, Roses, entre la Cala Canyelles i la Punta Falconera, 60 m, 31TEG17, 8-IV-1971, X. Llimona (BCC-Lich.5552).

Acknowledgments: We thank Dr. Diederich for critical discussion of the manuscript, Prof. X. Llimona and Dr. F. Valladares for the loan of some specimens of *Dimelaena oreina* and Dr. W. Sanders for revision of the English text. This study has been financed with funds of the Comisión Asesora de Investigación Científica y Técnica (CAICYT), project PB89-0415.

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ADDITIONAL SPECIES OF BUNODOPHORON (SPHAEROPHORACEAE, CALICIALES S. LAT., LICHENIZED ASCOMYCETES) FROM THE SOUTHERN HEMISPHERE

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Abstract: *Bunodophoron agnetae* Wedin is described as new to science and the new combination *Bunodophoron palmatum* (J. S. Murray) Wedin is suggested. *Bunodophoron agnetae* is reported from New Zealand and Chile, and *B. palmatum* is endemic to New Zealand.

Bunodophoron A. Massal. was recently resurrected (Wedin 1993) following a hypothesis on the phylogeny of the family Sphaerophoraceae (Caliciales s. lat.), based on a cladistic parsimony analysis. *Bunodophoron* includes the majority of the species formerly classified in the genus *Sphaerophorus* Pers. Additional species of in *Bunodophoron* have recently been described, following fieldwork in Chile in 1989, and in New Zealand during 1990 and 1992 (Wedin & Tibell 1991; Wedin 1992; Kantvilas & Wedin 1992). Here, two additional species are briefly discussed and described. A more detailed discussion of both species will appear in my forthcoming monograph of the family Sphaerophoraceae in the Southern Hemisphere.

***Bunodophoron agnetae* Wedin, sp. nov**

Fig. 1.

Similis *B. imshaugii*, sed differt sporis hyalinis vel subbrunneis, praesentia acidi isosphaerici et ascomatatis methylici.

Type: New Zealand, North Island, Wellington, Tararua State Forest, along track from Kiriwhakapapa entrance to Te Mira peak, at turn-off to Cow Creek Hut, 40°47'S, 175°30'E, alt. c. 1050 m, 1992, Wedin 2540 & Hörmell (UPS, holotype; isotypes will be distributed in Tibell: *Caliciales Exsiccatae*).

Etymology: The species is named in honour of my wife Agneta Hörnell, who has provided invaluable assistance and encouragement during my work.

Thallus very small, erect; forming patches of small sterile branches with somewhat larger fertile ones irregularly intermingled. Fertile branches narrowly flattened, c. 5-15 mm long and c. 1.5-5.5 mm wide, usually unbranched in the apical parts. Upper surface pale greenish to pale brownish, rarely almost white; usually smooth. Lower surface white. Ascomata common, terminal, c. 1-3.5 mm wide, smooth or weakly faveolate on the upper side. Mazaedia apically to subapically, rarely ventrally exposed; thalline receptacle ruptured very early in the development. Spores hyaline or with a pale brownish tinge, with a very small amount of mazaedial material adhering to the spore wall; c. 6.0-7.5(-9.0) μm in diam. Pycnidia occasional, in apices of small branchlets. Conidia bacilliform, c. 4.5-5.5(-6.0) $\times$ 1.5 μm .

Chemistry: Isosphaeric acid (major), sphaerophorin (minor), methyl ascomatate (major), protocetraric and salazinic acids (traces in the ascomata of Wedin 1455), and trace of an unknown substance (Elix, *in litt.*, based on Wedin 1455 and 2597). Protocetraric acid has been detected by TLC in the ascomata of most specimens. Several collections, however, lack

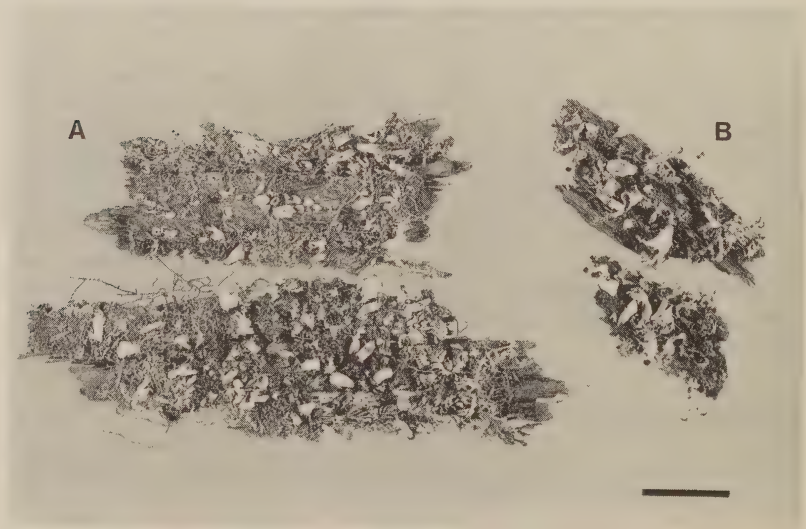


Fig. 1. *Bunodophoron agnetae* Wedin. A. Wedin 1452 (UPS), B. Wedin 2540 & Hörnell, holotype (UPS). Scale=2 cm.

this substance in amounts detectable by TLC. Methyl ascomatate is one of several new dibenzofuranes of widespread occurrence in *Bunodophoron*, and the structure of this and a number of related substances will be published soon (Elix et al., *in press*). Earlier reports of an unidentified substance turning blue after spraying with sulphuric acid (Tibell 1987; Kantvilas & Wedin 1992; Wedin 1992, 1993) refers to these dibenzofuranes. Medulla K-, C-, Pd+ orange (often faint), Pd+ red in apothecia.

Ecology and distribution: In New Zealand *B. agnetae* was collected in *Nothofagus*-dominated forests, often at relatively open sites on ridges, and here it seems to grow exclusively on rotting wood. In Chile it was collected in a coastal, very wet, regenerating *Fitzroya* forest where it grew on the bark of *F. cupressoides*. *Bunodophoron agnetae* thus is a further species showing an austral distribution in the cool temperate parts of the Southern Hemisphere.

Characterization: This species is very similar to *Bunodophoron imshaugii* (Ohlsson) Wedin in gross morphology, but differs in being smaller, having a less branched thallus, in having slightly smaller, almost hyaline or very pale brown spores, and a different chemistry. *Bunodophoron imshaugii* has distinctly reddish brown spores, and contains sphaerophorin, protocetraric acid and ascomatic acid, another dibenzofurane. *Bunodophoron agnetae* was included in *B. imshaugii* (as "*Sphaerophorus imshaugii*") by Wedin (1992), where taxonomic problems regarding this species were briefly discussed.

Selected specimens investigated: **Chile:** Chiloé: Chiloé Nat. Park, ca 8 km NNE Cucao and ca 4 km NE Laguna Huelde, Cordillera de Pichuen, slopes W Rio Cipresal, 42°34'S, 74°04'W, alt. 260 m., 1989, Mats Wedin 1452 (UPS), 1455 (UPS, ANUC). **New Zealand:** North Island: Wellington: Tararua State Forest, along track from Kiriwhakapapa entrance to Te Mira peak, 40°47'S, 175°30'E, alt. 920-1000 m., 1990, Mats Wedin 2557, 2558, 2559 (UPS); Tararua State Forest Park, along track over Kapakapanui Ridge, just above Kapakapanui Hut, 40°55'S, 175°09'E, alt. 825 m., 1990, Mats Wedin, 2597 (UPS, ANUC).

***Bunodophoron palmatum* (J. S. Murray) Wedin, comb. nov.**

Basionym: *Sphaerophorus melanocarpus* var. *australis* f. *palmatus* J. S. Murray 1960: 190. Type: New Zealand, South Island, Southland, Doubtful Sound, Thomson & Simpson 4/1957 (CHR, holotype).

Characterization: *Bunodophoron palmatum* belongs to a group of *Bunodophoron* species characterized by having large reddish brown spores and protocetraric acid. It is a large and broadly flattened species with large,

prominent apothecia. It is very similar in appearance to *Bunodophoron tibellii* Wedin in gross morphology, and in having the mazaedia exposed through a usually $\pm$ roundish hole in the crater-like receptacle. It cannot with certainty be separated from this species in the field, but is easily recognized on the smaller spores (c. 10-14(-16) μm in diam., compared with c. 14.5-18.5(-21) μm in *B. tibellii*) and by the chemistry, as *B. palmatum* lacks sphaerophorin. *Bunodophoron insigne* Laurer is usually smaller and has narrower branches, the mazaedium is exposed through irregular cracks in the receptacle when mature, and it always contains sphaerophorin.

Acknowledgements: Leif Tibell and Jan-Eric Mattsson are thanked for reading and commenting on drafts of the manuscript, and Thorsten Lumbsch is thanked for the constructive pre-submission review. Jack Elix and co-workers are gratefully acknowledged for chemical analyses. Karin Ryman and Ulla-Britt Sahlström have provided excellent technical assistance. The field work has been supported by grants from "Anna och Gunnar Vidfelts", "Regnells Botaniska", "Göransson-Sandviken", and "Hierta-Retzius" funds. This project has been funded the Swedish Natural Science Research Council as part of the project "Taxonomy of Caliciales".

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AN ANNOTATED LIST OF THE PUBLISHED NAMES IN MYCOSPHAERELLA AND SPHAERELLA: CORRECTIONS AND ADDITIONS.

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Abstract

Corrections and additions are provided to "An annotated list of the published names in *Mycosphaerella* and *Sphaerella*, Mycologia Memoir No. 18, J. Cramer, 1991" and the list is updated to the end of 1993.

Introduction

In the nearly three years since the manuscript was submitted to the publisher a number of errors and omissions has come to my attention. Soon after publication I began compiling a list of corrections and data additions to the main species list and the indices. Some references not seen prior to submission of the manuscript are now confirmed.

Additions also include names previously not listed in the host and anamorph indices. Although I have included new *Mycosphaerella* names and combinations published since 1991 to update the species listing it is not my intention to do this on a regular basis as these will be readily available in the Index of Fungi. I am grateful to Dr. M. Morelet (France) who has provided additional information not included in the book. It seemed appropriate now to publish this listing to make it available to those who may use Mycologia Memoir 18 as a reference source. The format of the following data is organized as described in the Introduction to Mycologia Memoir 18. The generic names *Mycosphaerella* and *Sphaerella* have been abbreviated to *M.* and *S.* respectively. All other generic names are spelled out in full. The spelling of some host plant generic names and the *Mycosphaerella* / *Sphaerella* epithets based on them has been corrected. Some of the plant generic names cited in Mycologia Memoir 18 are orthographic variants (Farr, E.R. et al., 1979, Index Nominum Genericorum (Plantarum). Article 73 of the International Code of Botanical Nomenclature (Greuter, W. (chairman), 1988) states that the original spelling of a name is to be retained although typographic and orthographic errors may be corrected.

I would like to thank Dr. M.E. Barr Bigelow, Sidney, British Columbia and Dr. S.J. Hughes, Agriculture Canada, Ottawa for critically reviewing the manuscript.

Correction to: Acknowledgments

Readhead SHOULD READ Redhead

Correction to: Introduction

p. 10 somec SHOULD READ some

List of *Mycosphaerella* and *Sphaerella*
names: Corrections to major entries
included in the book

abutilontidicola

ADD Anamorph: unspecified pycnidial fungus with oval, hyaline conidia.

achilleae

...d, *Achillea macrophylla*;...

agapanthi

M. agapanthi T.S. & K. Ramakrishnan...e, India) ADD ; see *agapanthi-umbellati* below.

albescens

SHOULD READ *M. albescens* (Rabenhorst) Lind ex Rehm, Ann. Mycol. 9:3. 1911; Rehm, Ascomyceten Exs., no. 1911. 1910 [label data not seen].

albizziae SHOULD READ **albiziae**

M. albizziae...(d, *Albizzia*...SHOULD READ *M. albiziae*...(d, *Albizia*...

andromedae-polifoliae

NEGRU AND SANDOR REFERENCE SEEN.

AFTER ...1965 ADD (a, 60-80; b, 25-35x8-12; c, 8-11x3.5-4; d, *Andromeda polifolia*).

aquilegiae J.B. Ellis & Galloway

ADD Synonym: *M. aquilegiae-jonesii* Tomilin, see below.

aquilina

AT END OF Synonyms: ...d, *Pteridium aquilinum*) ADD (Auerswald's Fig. 88 for *S. aquilina* illustrated several 3-septate ascospores); *Leptosphaeria aquilina* (Fries) G. Passerini, Atti Soc. Crittog. Ital. 2:47. 1879 (b, 28-35x6; c, 7.5-8x3/3-s).

araneosa

ADD Synonym: *Epicymatia araneosa* (Rehm) Saccardo, Syll. Fung. 1:572. 1882.

argentinensis

...Alcorn... SHOULD READ ...Alcorn, Punithalingam & McCarthy...

armoraciae

...Fungi neerl. Exs. no. 176. LABEL DATA SEEN.

artemisiae

ADD Anamorph: *Septoria nilgiriensis* S.T. Tilak, p. 217 (op. cit.).

ascoscypha

S. ascoscypha... SHOULD READ *S. ascoscypha*...

aspidiorum

ENTRY SHOULD READ *M. aquilina* (Fries) Schroeter forma *aspidiorum* (Saccardo) Jaap, Verh. Bot. Vereins Prov. Brandenburg 57:13. June 1915.

Basionym: *S. aquilina* (Fries) Auerswald forma *aspidiorum* Saccardo, Ann. Mycol. 7:435. Oct. 1909 (a, 70-80; b, 32-34x6-7; c, 9x2.5; d, *Aspidium filix-mas*; e, Germany).

asplenii

AT END OF *M. asplenii* (Auerswald)... ADD Reference: Saccardo, Syll. Fung. 2:82. 1883. Saccardo refers to *S. asplenii* Rabenhorst (= *Leptosphaeria asplenii* (Rabenhorst) Sacc.).

asteriniformis

...Everhart (1882) SHOULD READ ...Everhart (1888)

ADD aucupariae

S. aucupariae Plowright, Sphaeriacei Britannici [Exs.] Cent. II, no. 92. 1875, nomen nudum here. Plowright's collection is cited as type of *Didymosphaeria aucupariae* Oudemans, Rév. Champ. Pays-Bas 2:466. 1879 although the same collection is cited earlier in this publication (op. cit., p. 215) as a synonym of *M. aucupariae* (Lasch) Johanson ex Oudemans.

basicicola SHOULD READ **basicola**.**belladonnae**

...(d, *Belladonna*... SHOULD READ ...(d, *Atropa belladonna*...

bellona

HARA REFERENCE SEEN.

betulae Auerswald

ADD Saccardo and Trotter, Syll. Fung. 22:77. 1913 refer Auerswald's name to *Guignardia*, as *Guignardia betulae* (Auersw.) Sacc. & Trott.

bicalcarata

AT END, ADD Listed as *Ceriospora bicalcarata* (Ces.) Sacc. by Saccardo, Syll. Fung. 2:186. 1883.

boehmeriae

AT END, ADD Listed as *Metasphaeria boehmeriae* (Rabenh.) Sacc., by Saccardo, Syll. Fung. 2:156. 1883.

bombycina

...d, *Syzygium*... SHOULD READ ...d, *Syzygium*...

boquilae

...b, 40-12...SHOULD READ ...b, 40x12...

briardi

ADD Synonym: *S. patouillardi* Saccardo subspecies *briardi* Saccardo, Syll. Fung. 9:635. 1891.

ADD brumeliae

see **bumeliae**

brunnea (Berkeley & Curtis) M.C. Cooke

ADD Synonym: *Laestadia brunnea* (Berkeley & Curtis) Saccardo, Syll. Fung. 1:429. 1882, as *Laestadia* ? *brunnea*.

brunneola (Fries) Johanson

ADD References: J. Lind, Danish Fungi, p. 206. 1913 considers *M. subradians* (Fries: Fries) Schröter to be a synonym. Saccardo, Syll. Fung. 1:523. 1882 gives *Asteroma subradians* Fries as anamorph.

AT BOTTOM OF PAGE 55, *calmagrostis* SHOULD READ *calamagrostis*

callunae de Notaris

AT END, ADD Listed as *Physalospora callunae* (de Notaris) Sacc. by Saccardo, Syll. Fung. 1:447. 1882; probably identical to *Pseudophacidium ledi* (Albertini & Schweinitz) P. Karsten fide Arx & E. Müller, Beitr. Kryptogamenfl. Schweiz 11(1):171. 1954.

camelliae M.C. Cooke

ADD Synonyms: *Glomerella cingulata* (Stoneman) Spaulding & Schrenk, fide Arx & E. Müller, Beitr. Kryptogamenfl. Schweiz 11(1):188. 1954; *Laestadia camelliae* (M.C. Cooke) Berlese & Voglino, Syll. Fung., Add. ad Vol. 1-4:62. 1886, as *camilleae*.

caricae Maublanc

ADD Anamorph: *Asperisporium caricae* Maublanc, Bull. Soc. Mycol. Fr. 29:358. 1913.

Reference: S.J. Hughes, Canad. J. Bot. 31:575. 1953.

caroliniana

AFTER ...d, *Oxydendron* INSERT (= *Oxydendrum*)

carphae

M. carphae... SHOULD READ *M. carphae*...

cerasella

AFTER ...*Cercospora cerasella* Saccardo INSERT (= *C. circumscissa* Saccardo)

cerasina

M. carasina... SHOULD READ *M. cerasina*...

ceriospora

AT END, ADD Listed as synonym of *Ceriospora dubyii* Niessl by Saccardo, Syll. Fung. 2:185. 1883.

chamaemori L. & K. Holm

...1977... SHOULD READ ...1976...

chionanthi

AT END, ADD Listed as a synonym of *Hyponectria memecyli* Petch by Trotter, Syll. Fung. 24:643. 1926.

chrysanthemi

AFTER Reference: Walker...1983. ADD These authors consider *chrysanthemi* to be a species of *Mycosphaerella* and state that Garibaldi & Gullino (1971) were in error in transferring this species to *Didymella* and also in error in considering *M. ligulicola* K.F. Baker et al. to be a synonym of *M. chrysanthemi*. Walker & K.F. Baker also believe that

Ascochyta chrysanthemi F.L. Stevens is neither the anamorph of *M. chrysanthemi* nor a synonym of *Phoma chrysanthemi* Voglino as stated by Garibaldi & Gullino.

cleidonii SHOULD READ **cleidionii**

S. cleidionii... SHOULD READ *S. cleidionii*...

conglomerata (Wallroth) Lindau

UNDER Synonym, THE AUTHOR OF THE COMBINATION *S. conglomerata* IS NOT Auerswald in... BUT IS Rabenhorst, Fungi Europaei Exs., ed. nov., ser. 2, no. 150. 1860.

Auerswald in...*A. incana*) SHOULD READ ; reference: Auerswald in...*A. incana*).

...(c, 12x14/1-s... SHOULD READ ...12x4/1-s...

cruciferarum Reference: M.E. Barr...

...(=Apiaceae)... SHOULD READ ...(=Brassicaceae)...

AS LAST ENTRY UNDER **cruciferarum** ADD *S. cruciferarum* (Fries) Saccardo forma *alliariae* Rabenhorst.

cupaniae Basionym:...

...d, *Cuponia*... SHOULD READ ...d, *Cupania*...

cucurbitacearum

ADD Synonym: *Laestadia cucurbitacearum* (Fr.) Saccardo, Syll. Fung. 2:XXXIII. 1883, as *cucurbitacearum* (Schw. in Fr.). Sacc.

dactylidis

KIRCHNER REFERENCE SEEN.

davisii

...d, *Melilotus*... SHOULD READ ...d, *Melilotus*...

ADD dealbans

?*S. dealbans* J. Müller Arg., Flora 56:507. 1872.

Synonym: *Pharcidea dealbans* (J. Müller Arg.) Saccardo & D. Saccardo, Syll. Fung. 17:647. 1905 (a, 200; b, 45-50 long; c, 14-18 long; d, *Endocarpon loscoi* [lichen]; e, Spain).

denigrans

ADD Synonym: *M. phlomidicola* Tomilin, Nov. Sist. Niz. Rast. 1966, p. 150. 1966.

ADD destructiva

S. destructiva Berkeley & Broome, Trans. Linn. Soc. London, Bot., ser. 2, 2:71. 1882.

Synonym: *Laestadia destructiva* (Berkeley & Broome) Berlese & Voglino, Syll. Fung. Addit. ad Vol. 1-4, p. 62. 1886. Saccardo, Syll. Fung. 15:338. 1901 lists both *S. destructiva* (Berkeley & Broome) and *S. destructiva* Ellis & Everhart as synonyms of *Laestadia destructiva* (Berkeley & Broome) Berlese & Voglino.

dipsasci-sylvestris

AFTER ...no. 324 ADD . 1880

disseminata

Erbario Crittog. Ital., ser. 2, no. 391. LABEL DATA SEEN.

distincta

ADD **Current Name:** *Didymella distincta* (P.A. Karsten) O.E. Eriksson, Ark. Bot. 6(10):448. 1967.

echinophila Auerswald

ADD **Synonym:** *Laestadia echinophila* (Auerswald) Saccardo, Syll. Fung. 1:425. 1882, as (Cesati) Sacc.

effigurata

AT END OF ENTRY, ADD **Anamorphs:** *Asteromella fraxini* (Berkeley & Curtis) Petrak and *Marssonina fraxini* J.B. Ellis & Davis, fide F.A. Wolf and Davidson, pp. 533 & 535 (op. cit.).

errabunda

UNDER **Anamorph,** ADD Morelet, Rev. Forest. Franç. 41:491.1989, considers the anamorph of *Apiognomonina errabunda* to be *Discula umbrinella* (Berkeley & Broome) Morelet.

erythrinicola

ADD **Synonym:** *M. erythrinae* Koorders fide Tomilin Opredeletel'gribov roda *Mycosphaerella* Johans., p. 116. 1979.

eumorpha

ADD **Synonym:** *Leptosphaeria eumorpha* (Berkeley & Curtis) F.S. Earle, Bull. Torrey Bot. Club 25(7):361. 1898.

euphorbiae Phillips & Plowright

ADD **Synonym:** *Physalospora euphorbiae* (Phillips & Plowright) Saccardo, Syll. Fung. 1:436. 1882.

exarida

M. exaroda (Winter) Tomilin... SHOULD READ *M. exarida* (Winter) Tomilin...

exitalis and *M. exitalis* (Morini) Cruchet and *M. exatalis* (Morini) Jaczewski SHOULD BOTH READ **exitialis**... *M. exitialis*...

festucae (Libert) Auerswald

ADD **Synonym:** *Physalospora festucae* (Libert) Saccardo, Syll. Fung. 1:434. 1882.

foeniculi Komirnaya

...Index Fungi, p. 489 (op. cit.) SHOULD READ ...Index of Fungi 3:489. 1969.

fraxinicola

AT END OF ENTRY, ADD **Reference:** F.A. Wolf, Mycologia 31:258-266. 1939.

ADD **Anamorph:** *Phyllosticta viridis* J.B. Ellis & Kellerman fide Wolf, p. 264 (op. cit.).

ADD galatea

S. galatea Saccardo variety *centranthi* González Frago.

gangraena

ADD **Current Name:** *Telimenella gangraena* (Fries) Petrak, Sydowia 1:79. 1947. See M.E. Barr, Mycologia 69:995 1977 for additional synonyms.

ADD helodis

see **elodis**

hieracii

UNDER *M. hieracii* (M.C. Cooke & Massee)...*Ascochyta* SHOULD READ ...*Ascochyta*

honckenya SHOULD READ **honkenyae**

M. honckenya..d, *Honckenya*..SHOULD READ *M. honkenyae*..d, *Honkenya* [= *Arenaria*] *peplodes*, as *Honckenya peplodes*..

hordei

KIRCHNER REFERENCE SEEN.

hosackiae

AFTER ... e, U.S.A.). ADD Bonar found only *Microdiplodia hosackiae* Bonar (op. cit., p. 385) on the type collection. A second collection by Bonar on *Hosackia* bore the *Microdiplodia* and a *Mycosphaerella* similar to the description of *Sphaerella hosackiae* M.C. Cooke & Harkness. Bonar described the species as *Mycosphaerella hosackiae* Bonar.

ADD Synonym: *Ditopella hosackiae* (M.C. Cooke & Harkness) Saccardo, Syll. Fung. 1:451. 1882.

hyalospora

Basionym: *S. hyalospora* Cesati... SHOULD READ *Sphaeria hyalospora* Cesati...

insularis

ADD Synonym: *S. insularis* (Wallroth) Saccardo, Syll. Fung. 1:535. 1882, a superfluous combination.

intermixta Berkeley & Broome

ADD Synonym: *Sphaerulina intermixta* (Berkeley & Broome) Saccardo, Fungi ital. autographice delineati, tab. 347. 1878, as *Sphaerulina (Pringsheimia) intermixta* (B. & Br.) S. (a, 80-100; b, 60-70x17; c, 16-18x7-8/3-4-s; d, *Rubus fruticosus*; e, Italy). Also see Wehmeyer, Mycologia 49:83-94. 1957 for comments on *S. intermixta*.

ischnosperma

S. ischnosperma...SHOULD READ *S. ischnosperma*...

jonkerschoekensis SHOULD READ **jonkershoekensis**

M. jonkerschoekensis... SHOULD READ *M. jonkershoekensis* ...

juncellina

ADD Reference: L. & K. Holm, Arctic & Alpine Mycology II, p. 118. 1987.

kakomensis

...(=Apiaceae)... SHOULD READ ...(=Brassicaceae)...

killianii

AFTER Synonym: ... Persoon: Fries INSERT (1823).

Moesz (1926) SHOULD READ Jaczewski (1916)

laphathi

UNDER Anamorph: ...*Ramulariae*... SHOULD READ ...*Ramularia*...

lapponum

ADD Synonym: *Didymella lapponum* (de Notaris) Saccardo, Syll. Fung.

1:548. 1882.

latispora

?*M. linicola* Naumoff variety *latispora*., AFTER ..1927, ADD (d, *Linum*)

leersiae

ADD Synonym: *Metasphaeria leersiae* (Passerini) Saccardo, Syll. Fung. 2:173. 1883.

lepidiotae

ADD Synonym: *Metasphaeria lepidiotae* (Anzi) Saccardo, Syll. Fung. 2:184. 1883.

leptosphaerioides

ADD Synonym: *Leptosphaeria auerswaldii* Saccardo & Traverso, Syll. Fung. 19:1096. 1910.

leucophaea

...*leucophea*... SHOULD READ ...*leucophaea*...

libanotis AND variety *libanotis* SHOULD READ **libanotidis** AND variety *libanotidis*

AT BEGINNING OF ENTRY, INSERT *M. libanotidis* (Fuckel) Lind, Danish Fungi, p. 203. 1913.

PRECEDING *S. eryngii*... ADD Basionym:

ADD Anamorph: *Asteroma libanotidis* Diedicke, Ann. Mycol. 9(5):542. 1911.

ligulicola

ADD See comments under *M. chrysanthemi* (Tassi) Tomilin.

lusitanica

ADD Synonym: *Laestadia lusitanica* (Auerswald) Saccardo, Syll. Fung. 1:425. 1882.

lychnidicola SHOULD FOLLOW **luzulae**

lycopodii

INSERT Basionym: BEFORE *S. lycopodii* Peck...

lysismachiae

COMBINATION TO *MYCOSPHAERELLA* MADE BY Höhnelt, Ann. Mycol. 3:556. 1905, as *Mycosphaerella lysismachiae* v. Höhn.

M. lysismachiae (Höhnelt) Jaap IS A SUPERFLUOUS COMBINATION.

macleyae SHOULD READ **macleayae**

M. macleyae...(d, *Macleya*... SHOULD READ *M. macleayae*...(d, *Macleaya*...

Synonym: *S. macleyae*...1928 SHOULD READ *macleayae*...1928, as *Sphaerella macleayae*.

macrospora

UNDER Anamorph, JOURNAL TITLE: Tijdschr. Plantenziekten SHOULD READ Netherlands J. Pl. Pathol. VOLUME, PAGE AND YEAR ARE CITED CORRECTLY.

macularis

UNDER **Current Name:** ADD Rulamort, Bull. Soc. Bot. Centre-Ouest, Nouvelle Sér. 17:191. 1986, considers *Venturia maculosa* (Saccardo)

Rulamort to be the correct name.

UNDER Anamorph, ADD However, Morelet (Cryptog. Mycol. 6:103. 1985) considers *Pollaccia radiosa* to be the anamorph of *Venturia tremulae* Aderhold.

maculosa

UNDER Current Name. RULAMORT REFERENCE SEEN.

major

Current Name...1950. ADD According to Morelet (communication), probably not a synonym of *Venturia macularis* (Fries) E. Müller but perhaps of *Venturia ditricha* (Fries) P.A. Karsten but this is uncertain as authentic material lacking.

mandshurica

..mandshirica.. SHOULD READ ..mandshurica...

ADD Anamorphs: An unspecified acervular fungus with brown, 3-6-septate conidia and a *Phyllosticta* fide Miura (op. cit., pp. 161-162).

manihotis Ghesquière & Henrard

AFTER Current name: *M. henningsii* Sivanesan,... ADD Trans. Brit. Mycol. Soc. 84:552. 1985

marii

ADD Synonym: *Laestadia marii* (de Notaris) Saccardo, Syll. Fung. 1:425. 1882

melaena

ADD Synonyms: *Omphalospora melaena* (Fries) Höhnelt, Sitzungsber. Kaiserl. Akad. Wiss. Math.-Naturwiss. Cl. 128:603. 1919 [Fragmente zur Mykologie 1179]; *Asterina melaena* (Fries) Saccardo, Syll. Fung. 1:48. 1882.

meliosmae

...Ramakrishnan... SHOULD READ ...T.S. Ramakrishnan...

melonis

Basionym: *Didymella melonis*... AFTER 1885, ADD (b, 62-80x10-12; c, 17.5x7.5/1-s; d, *Cucumis melo*; e, Italy).

microspora Auerswald

ADD Synonym: *Laestadia microspora* (Auerswald) Saccardo, Syll. Fung. 1:424. 1882

milleri

Anamorph: AT THE END OF ANAMORPH REFERENCE, ADD (= *Phaeoisariopsis magnoliae* (J.B. Ellis & Harkness) Jong & Morris, but better placed in *Passalora* fide Deighton, Mycol. Res. 94:1101. 1990).

molleriana

AFTER ... 1897, ADD , a synonym of *M. nubilosa* (M.C. Cooke) Hansford fide Crous et al., Mycol. Res. 95(5):628. 1991.

mori

...Wolf... SHOULD READ ...F.A. Wolf...

ADD Reference: Boerema & Verhoeven, Netherlands J. Pl. Pathol. 79:171. 1973 cite the name as *M. mori* (Fuckel) ex Wolf and give the anamorph as *Phloeosporrella maculans* (Bérenger) Höhnelt.

myrtillii and *S. myrtillii* SHOULD READ **myrtilli** and *S. myrtilli*

napicola

ADD **Current Name:** *M. cruciferarum* (Fuckel) Lindau fide Tomilin,
Opredelitel'gribov roda *Mycosphaerella* Johans., p.77. 1979.

nemesiae ENTRY SHOULD FOLLOW **nectrandrae**.

nerviseda

AT BEGINNING OF ENTRY ADD *M. nerviseda* (Spegazzini) Lindau,
Hilfsb. Sammelen Ascomyceten, p. 62. 1903.

IN FRONT OF *S. nerviseda* Spegazzini ADD Basionym:

nevodovskii

M. nevodovskii... SHOULD READ *M. nevodovskii*...

nigerristigma

...*pennsylvanica*... SHOULD READ ...*pennsylvanica*...

nigrificata

...*stolonifera*... SHOULD READ ...*stolonifera*...

nubilosa

ADD Synonym: *M. molleriana* (Thümen) Lindau fide Crous et al. Mycol.
Res. 95(5):628. 1991.

oenanthicola

ADD Synonym: *Laestadia oenanthicola* (Fuckel) Saccardo, Syll. Fung.
1:431. 1882.

olindensis

M. olendensis... SHOULD READ *M. olindensis*...

othonnopsidis

...*Orthonnopsis*... SHOULD READ ...*Othonnopsis*...

oxyriae

ADD Reference: Tomilin, Opredelitel'gribov roda *Mycosphaerella*
Johans., p. 271. 1979.

panicum

ADD Synonym: *Metasphaeria panicum* (M.C. Cooke) Saccardo, Syll.
Fung. 2:176. 1883, as *Metasphaeria panicorum*.

ADD **patouillardii**

S. patouillardi Saccardo subspecies *briardii*

peckii Spegazzini

Synonym: SHOULD READ Synonyms:

TO SYNONYMS, ADD ; *Metasphaeria peckii* (Spegazzini) Saccardo,
Syll. Fung. 2:172. 1883.

perexigua Starbäck

S. perexigua... SHOULD READ *M. perexigua*...

ADD Synonym: *S. starbackii* Saccardo & Traverso, Syll. Fung. 20:828.
1911, nomen novum replacing an illegitimate name (Article 72).

perexigua Thümen

M. perexigua Thümen... SHOULD READ *M. perexigua* Fuckel ex
Thümen...

Austriacci... SHOULD READ Austriaci...

...(not seen). SHOULD READ ..., nomen nudum [label data seen].

personata

AT THE END OF ANAMORPH REFERENCE, ADD
(=*Phaeoisariopsis vitis* (Léveillé) Sawada fide Deighton, Mycol. Res. 94:1102. 1990).

phaseoli Chona & Munjal

ADD Anamorph: *Cercospora kikuchii* Matsumoto & Tomoyasu, Ann. Phytopathol. Soc. Japan 1(6):10. 1925 fide Chona & Munjal (op. cit., p. 54).

ADD philodendri

see **philodendronis**

phlomidicola

...U.S.S.R.) ADD , a synonym of *M. denigrans* (Kirschstein) Tomilin, fide Tomilin, Oprelidelitel'gribov roda *Mycosphaerella* Johans., p. 77. 1979.

phoenicis

ADD Synonyms: *Phomopsis cesati* González Fragoso, Asoc. Esp. Prog. Ci. 6:39. 1921 fide Syll. Fung. 26:938. 1972; *Phoma phoenicis* (Cesati) Saccardo, Syll. Fung. 11:493. 1895

pinifolia

ADD Synonym: According to Morelet (communication), *Sphaerella pinifolia* Ducomet is probably synonymous with *Stomiopeltis pinastri* (Fuckel) Arx in E. Müller & Arx, Beitr. Kryptogamenfl. Schweiz 11(2):545. 1962, non *Stomiopeltis pinastri* Ahmad (1978 (1979?))

pithecolobiicola SHOULD READ **pithecellobiicola**

M. pithecolobiicola...1972 SHOULD READ *M. pithecellobiicola*...1972, as *pithecolobiicola*.

Basionym: *S. pithecolobiicola*...1922 (...d, *Pithecolobium*... SHOULD READ *S. pithecellobiicola*...(...d, *Pithecellobium* (as *Pithecolobium*)...

polygonati

ADD Synonyms: *Guignardia polygonati* (Schweinitz) Lindau in Engler & Prantl, Natürlichen Pflanzenf. 1(1):423. 1897; *Laestadia polygonati* (Schweinitz) Saccardo, Syll. Fung. 2:XXXII. 1883.

polygonorum Auerswald

ADD Synonym: *Laestadia polygonorum* (Auerswald) Saccardo, Syll. Fung. 2:XXXII. 1883

polypodii

M. polypodii (Rabenhorst) Jaap, Fungi Selecti Exs. no. 882. 1918...
LABEL DATA SEEN.

praecox

...Erbario Crittog. Ital. no. 987.. LABEL DATA SEEN.

pseudoacaciae SHOULD READ **pseudacaciae**

...*pseudoacaciae* SHOULD READ ...*pseudacaciae*

..*Robinia pseudoacaciae* SHOULD READ ..*Robinia pseudacacia*

psorae

ADD Synonym: *Metasphaeria psorae* (Anzi) Saccardo, Syll. Fung. 2:183.

1883.

punctoidea

ADD Synonym: *Laestadia punctoidea* (M.C. Cooke) Auerswald, Hedwigia 8:177. 1869.

quercina

ADD Anamorph: *Aposphaeria quercina* Jaczewski, Bull. Soc. Mycol. Fr. 12(3):104. 1896.

rauwolfiae SHOULD READ **rauwolfiae**

M. rauwolfiae...1950 (...d, *Rauwolfia*... SHOULD READ *M. rauwolfiae*...1950, as *rauwolfiae* (...d, *Rauwolfia* (as *Rauwolfia*)...

retinosporae SHOULD READ **retinisporae**

M. retinosporae...1905 SHOULD READ *M. retinisporae*...1905, as *retinisporae*.

Basionym: *S. retinosporae*...1889 (...d, *Retinospora*... SHOULD READ *S. retinisporae*...1889, as *retinosporae* (...d, *Retinispora* (as *Retinospora*) ...

ribis

SHOULD READ *M. ribis* Feltgen, ... nomen novum replacing an illegitimate name (Article 72). The basionym *Sphaeria ribis* Fuckel (1870) is a later homonym (illegitimate, Article 64) of *Sphaeria ribis* Tode: Fries, Systema Mycol. 2:413. 1823 (= *Nectria cinnabarina* (Tode: Fries) Fries, fide Boerema, Nederlands J. Pl. Pathol. 78(suppl.):70. 1972.

rosigena

..McMurrin in Stewart.. SHOULD READ ..McMurrin ex F.C. Stewart ...

AFTER ... Sta. INSERT (Geneva)

rouxii

ADD Synonym: *Laestadia rouxii* (Montagne) Saccardo, Syll. Fung. 1:428. 1882.

rubi Roark

AFTER Anamorph: ... (op. cit.) ADD although as Demaree and Wilcox, (Phytopathology 33:997. 1943) pointed out, no other workers up to 1943 [and also presumably up to the present] have demonstrated the connection between *Septoria rubi* Westendorp and a *Mycosphaerella*.

AFTER **ruthenica**, **vsabavlidis** SHOULD READ **sabavlidis**

sabalis

ADD Anamorph: *Coniothyrium sabalis* Sousa da Camara, p. 41 (op. cit.), as *sabalidis*.

sarmentorum

ADD Synonym: *Leptosphaeria vitigena* Saccardo, Syll. Fung. 2:29. 1883.

schumacheri

AFTER Synonym: *Microascus* ... 1931 ADD ; Saccardo, Syll. Fung. 1:276. 1882 transferred *schumacheri* to *Rosellinia* as *Rosellinia schumacheri* (C.E. Hans.) Sacc. but this is incorrect as Hansen's species belongs in the Microascaceae.

scirpi-lacustris

ADD Anamorph: *Rhabdospora scirpi* (Saccardo) Allescher in Rabenhorst, Kryptog.-Fl. Deutschl., Osterr. Schweiz 1(6):922. 1901.

securigineae

...(d,...*subfruticosa*... SHOULD READ ...(d,...*suffruticosa*...

AFTER ...e, U.S.S.R.) ADD ; host genus unlisted in Index Kewensis.

serrulata J.B. Ellis & Everhart

ADD Synonym: *Laestadia serrulata* (J.B. Ellis & Everhart) Saccardo, Syll. Fung. 9:586. 1891, as *serrulatae*.

ADD simulans

S. simulans M.C. Cooke, sensu Berlese & Bresadola, Ann. Soc. Alpin Tridentini 14:27. 1887-1888 [1889] (b, 50-60x9-12; c, 20-22x4-5/1-s; d, *Quercus*; e, Italy). Although Berlese and Bresadola cited the name *simulans* Cooke, Trotter, Syll. Fung. 24:864. 1928 obviously considered the Berlese and Bresadola collection to be distinct from *simulans* M.C. Cooke, listing it as a synonym of *S. berlesiana* Traverso.

sparsa

ADD Synonym: *S. punctiformis* (Persoon: Fries) Rabenhorst [= *M. punctiformis* (Persoon: Fries) Starbäck] fide Saccardo, Syll. Fung. 1:476. 1882.

spinicola (G. Passerini) Tomilin

...*Hippopha*... SHOULD READ *Hippophaë*...

spinicola J.B. Ellis & Everhart

ADD Synonyms: *Laestadia spinicola* (J.B. Ellis & Everhart) Saccardo, Syll. Fung. 9:582. 1891 but a synonym of *Glomerella cingulata* (Stoneman) Spaulding & Schrenk fide M.E. Barr (communication); *Guignardia spinicola* J.B. Ellis & Everhart) Lindau in Engler & Prantl, Natürlichen Pflanzenf. 1(1):423. 1897.

stellariae

ADD Synonym: *S. isariphora* (Desmazières) Johanson fide Saccardo, Syll. Fung. 1:510. 1882.

stigmatodes

Berkeley & Curtis SHOULD READ M.C. Cooke. AFTER ...U.S.A.). ADD The name *S. stigmatodes* Berkeley & Curtis has not been found and it is presumed that the name was first published by Cooke and not Berkeley & Curtis.

ADD Synonym: *Laestadia stigmatodes* (M.C. Cooke) Saccardo, Syll. Fung. 2:XXXI. 1883, as *stigmatodes* (B. & C.) Sacc.

subcongregata

AFTER ...original description. ADD *S. subcongregata* sensu Saccardo, Syll. Fung. 9:651. 1891 is considered by Saccardo & D. Saccardo, Syll. Fung. 17:644. 1905, to be a synonym of *S. smilacina* J.B. Ellis & Everhart.

subradicans

ADD Reference: J. Lind, Danish Fungi, p. 206. 1913 considers *M.*

subradians (Fries: Fries) Schroeter to be a synonym of *M. brunneola* (Fries) Johanson.

ADD syconophila

see *ficophila*

AFTER ... *tassiana*..variety *pusilla* .., ADD THE FOLLOWING ENTRY

tassiana

S. tassiana de Notaris variety *rupefortensis* G. Passerini.

thallina

ADD Synonym: *Epicymatia thallina* (M.C. Cooke) Saccardo, Syll. Fung. 1:572. 1882.

todeae

ADD Synonym: *Sphaerulina todeae* (M.C. Cooke) Berlese & Voglino, Syll. Fung. Addit. ad vol. 1-4:159. 1886.

typharum

Herb. Vivum Mycol. ed. nov., no.731. 1858. LABEL DATA SEEN; ...(c, 1-S) SHOULD READ ...(c, 4-s; d, *Typha*; e, Germany).

ulmi

AFTER Anamorph: ... 1833 ADD and *Phyllosticta bellunensis* Martelli, Nuovo Giorn. Bot. Ital. 20:395. 1888.

...P. 263... SHOULD READ ...p. 236...

ulmifolia

AFTER ...no. 1281 ADD [year likely 1883]

vaginae

ADD Synonym: *Laestadia vaginae* (Lasch) Saccardo, Syll. Fung. 1:431. 1882.

veneta

ADD **Current Name:** *Apiognomonina veneta* (Saccardo & Spegazzini) Höhnelt, Ann. Mycol. 16:51. 1918.

ADD Anamorph: *Discula nervisequa* (Fuckel) Aloj, Nanni, Marziano & Noviello, Micol. Ital. 22(2):17. 1993.

ADD vitis

S. vitis Schulzer, Verh. K. Zool.-Bot. Ges. Wien 20:643. 1870 [month of publication unknown] (c, 26x7/3-s; d, *Vitis*; e, Austria) non *S. vitis* Fuckel (1870) [published between Feb. 18 and Nov. 28, 1870: Stafleu & Cowan, vol. 1:896. 1976]. I do not know which name has priority.

Synonyms: *Leptosphaeria vitigena* Saccardo, Syll. Fung. 2:29. 1883; *S. vitigena* Saccardo, Syll. Fung. 2:29. 1883, probably a nomen novum for *S. vitis* Schulzer as Saccardo presumably would have been aware of *S. vitis* Fuckel.

weigeliae SHOULD READ weigelae.

M. weigeliae...1910 (...d, *Weigelia*... SHOULD READ *M. weigelae*...1910, as *weigeliae* (...d, *Weigela* (as *Weigelia*)...

Synonym: *S. weigeliae*...1913 SHOULD READ *S. weigelae*...1913, as *weigeliae*.

zeae

KIRCHNER REFERENCE SEEN.

zizyphi SHOULD READ **ziziphi**

S. zizyphi...(d, *Zizyphus*... SHOULD READ *S. ziziphi*...(d, *Ziziphus* (as *Jubier*)...

zizyphicola SHOULD READ **ziziphicola**

M. zizyphicola...(d, *Zizyphus*... SHOULD READ *M. ziziphicola*...(d, *Ziziphus* (as *Zizyphus*)...

List of *Mycosphaerella* and *Sphaerella* names: Names not previously included and names published after 1990

angustifoliorum

M. angustifoliorum Ramaley, Mycotaxon 40:17. 1991 (a, 125-200x150-210; b, 70-115x15-25; c, (45)51-69(82)x5-6.5/1-s; d, *Populus angustifolia*; e, U.S.A).

Anamorphs: *Clypeispora angustifoliorum* Ramaley, p. 13 (op. cit.); *Asteromella angustifoliorum* Ramaley, p. 19 (op. cit.).

aquatica

M. aquatica K. Udaiyan & V.S. Hosagoudar, J. Econ. Tax. Bot. 15(3):661. 1991 (a, 525-755x300-400; b, 45-60x12.5-15; c, 15-18.5x5-7/1-s; d, *Pinus* & beech [*Fagaceae*] wood; e, India). Probably not a *Mycosphaerella*. According to Index of Fungi 6(5): January 1993, not validly published (Article 37.1; (see Article 9.5) 37.3) as holotype not designated.

bellula

M. bellula Crous & Wingfield, Mycotaxon 46:20. 1993 (a, 90-150x80-130; b, 30-(45.7)58x7-(8)10; c, 7-(8.8)11x2-(2.5)3/1-s; d, *Protea repens*; e, S. Africa).

capsellae

M. capsellae Inman & Sivanesan in Inman, Sivanesan, Fitt & R.L. Evans, Mycol. Res. 95:1339, 1991 (a, 70-116; b, 32-53x8-14; c, 15-23x3-3.5; d, *Brassica napus* ssp. *oleifera*; e, U.K.).

Anamorph: *Pseudocercospora capsellae* (J.B. Ellis & Everhart) Deighton, Mycol. Pap. 133:42. 1973.

caryophyllea

S. caryophyllea M.C. Cooke & Harkness in Cooke, Grevillea 14:9. 1885, as *Sphaerella* (*Laestadia*) *caryophyllea* (c, 20x7.5; d, *Dianthus*; e, U.S.A.)

Synonym: *Laestadia caryophyllea* (M.C. Cooke & Harkness) Berlese & Voglino, Syll. Fung., Addit. ad Vol. 1-4:62. 1886.

cussoniae

M. cussoniae Crous & Wingfield, Mycotaxon 46:22. 1993 (a, 90-120x80-100; b, 40-55(65)x10-(15)17; c, 26-(35)40x(4)6/1-s; d, *Cussonia thyrsiflora*; e, S. Africa).

Anamorph: spermogonial state.

destructiva

S. destructiva Berkeley & Broome, Trans. Linn. Soc. London, ser. 2, 2:71. 1882 (b, 7.6 [probably 76] long [0.0003 inch?]; c, 12.7 long [0.0005 inch]; d, Lucern[e] [*Medicago sativa*]; e, Australia).

Synonym: *Laestadia destructiva* (Berkeley & Broome) Berlese & Voglino, Syll. Fung. Addit. ad Vol. 1-4, p. 62. 1886 (b, 75 long; c, 12 long).

dichrostachydis

M. dichrostachydis van der Byl, S. African J. Sci. 25:186. 1928 (a, 233-300x133-183; b, 88-116x12-16; c, 16-20x8-9/1-s; d, *Dichrostachys nyassana*; e, Zimbabwe [as Rhodesia]).

halophila

M. halophila (E. Bommer, M. Rousseau & Saccardo) O.E. Eriksson, The non-lichenized pyrenomycetes of Sweden (New combinations and names), 1992.

Basionym: *Lizonia halophila* Bommer, Rousseau & Saccardo in Saccardo, Syll. Fung. 9:680. 1891 (a, 60-115 wide, 90-110 high; b, 48-54x18-21; c, 21-24x6-6.5/1-s; d, *Honkenya peploides* (as *Honkenyae* (Arenariae) *peplidis*)).

holmii

M. holmii O.E. Eriksson, The non-lichenized pyrenomycetes of Sweden (New combinations and names), 1992, nomen novum (Article 72).

Synonym: *M. chamaemori* L. & K. Holm, Kew Bull. 31(3):571. 1977 (or 1976), later homonym (illegitimate, Article 64), non *M. chamaemori* (P.A. Karsten) Lindau (1897).

lucillae

?*S. lucillae* Saccardo, Syll. Fung. 3:487. 1884, a nomen nudum here. No original description has been seen. Referred to under the description of *Septoria piricola* Desmazières (op. cit., p. 487): "Spermogonium *Sphaerellae lucillae* Sacc, videtur".

marasasii

M. marasasii Crous & Wingfield, Mycol. Res. 95(9):1111. 1991 (a, 70-120; b, 31-50x10-17; c, 10-20x2.5-4/1-s; d, *Syzygium cordatum*; e, S. Africa).

Anamorph: *Pseudocercospora marasasii* Crous & Wingfield, p. 1111.

parkii

M. parkii Crous, Wingfield, Ferreira & Alfenas, Mycol. Res. 97(5):582. 1993 (a, up to 90 wide, 100 high; b, 22-40x6.25-11; c, 8.75-14x2.5-3/1-s; d, *Eucalyptus grandis*, *E. dunnii*; e, Brazil).

rosae

S. rosae Auerswald, Mycol. Europaea. Synop. Pyreno. Europ. Heft 5 & 6, tab. 7, fig. 96, asci and ascospores without dimensions and lacking a description (nomen nudum).

Synonym: *Laestadia rosae* Auerswald, Hedwigia 8(12):178. 1869 (a, 100; b, 50x18; c, 15x7/0-s; d, *Rosa canina*; e, Germany); Syll. Fung. 1:420. 1882.

starbackii

S. starbackii Saccardo & Traverso, Syll. Fung. 20:828. 1911, nomen novum replacing an illegitimate name (Article 72).

Synonym: *M. perexigua* Starbäck, Ark. Bot. 5:21. 1905 (a, 75-100; b, 30-33x7.5-9; c, 12.5-13x3-3.5/1-s; d, Asteraceae; e, Bolivia), a later homonym (illegitimate, Article 64) of *M. perexigua* (P.A. Karsten) Johanson (1884).

suberosa

M. suberosa Crous, Ferreira, Alfenas & Wingfield, Mycologia 85(4):707. 1993 (a, 100-145 wide, 130 high; b, 35-60x10-14; c, 10-17x3-6/1-s; d, *Eucalyptus dunnii*, *E. grandis*; e, Brazil).

vitigena

S. vitigena Saccardo, Syll. Fung. 2:29. 1883 (also *E. Mussat*, Syll. Fung. 15:840. 1901), presumed nomen novum for *S. vitis* Schulzer, Verh. K. Zool.-Bot. Ges. Wien 20:643. 1870, non *S. vitis* Fuckel (1870).

Host Index

ALBIZZIA SHOULD READ ALBIZIA

albizziae SHOULD READ *albiziae*.

ALEUROPUS

aleuropodis: HOST AND FUNGUS NAMES NOT IN SPECIES LIST, DELETE BOTH.

ALTHAEA SHOULD BE LISTED AFTER ALSTROEMERIA

ASPHODELINA SHOULD READ ASPHODELINE

UNDER ATROPA, ADD *belladonnae*

BELLADONNA, DELETE ENTRY FOR HOST AND FUNGUS EPITHET

BLECHNUM SHOULD BE LISTED AFTER BIGNONIACEAE

BRACHYCOME SHOULD READ BRACHYSCOME

UNDER BRASSICA, ADD *capsellae*

UNDER CAREX, DELETE *caricae*

ADD CARICA

UNDER CARICA, ADD *caricae*

CHAMAENERIUM SHOULD READ CHAMAENERION

CLEIDON SHOULD READ CLEIDION

cleidonii SHOULD READ *cleidionii*.

ADD CUSSONIA

UNDER CUSSONIA, ADD *cussoniae*

UNDER DIANTHUS, ADD *caryophyllaea*

ADD DICHROSTACHYS

UNDER DICHROSTACHYS, ADD *dichrostachydis*

UNDER EUCALYPTUS, ADD *parkii* and *suberosa*

HONCKENEYA SHOULD READ HONKENYA (= ARENARIA)

UNDER HONKENYA, ADD *halophila*

LINNEA SHOULD READ LINNAEA

MACLEYA SHOULD READ MACLEAYA

macleayae SHOULD READ *macleayae*.

UNDER MEDICAGO, ADD *destructiva*

OXYDENDRON SHOULD READ OXYDENDRUM (= OXYDENDRON)

PITHECOLOBIUM SHOULD READ PITHECELLOBIUM

(= PITHECOLOBIUM)

UNDER POPULUS, ADD *angustifoliorum*

UNDER PROTEA, ADD *bellula*

RAUWOLFIA SHOULD READ RAUVOLFIA

rauwolfiae SHOULD READ *rauwolfiae*.

RETINOSPORA SHOULD READ RETINISPORA (= RETINOSPORA)

retiniosporae SHOULD READ *retinisporae*.

RHAPHITAMNUS SHOULD READ RHAPHITHAMNUS

rhaphitamni SHOULD READ *rhaphithamni*

ROBINA SHOULD READ ROBINIA

UNDER ROSA, ADD *rosae*

SAPORARIA SHOULD READ SAPONARIA

SECURIGINEA SHOULD READ ?SECURIGINEA (NOT LISTED IN INDEX KEWENSIS)

SYZGIUM SHOULD READ SYZYGIUM

AFTER *bombycina*, ADD *marasii*

THYSSELINUM SHOULD READ THYSSELINUM (=SELINUM)

WAGNERA SHOULD READ VAGNERA (=WAGNERA)

wagnerae SHOULD READ *vagnerae*.

WEIGELIA SHOULD READ WEIGELA (=WEIGELIA)

weigeliae SHOULD READ *weigelae*.

ZIZYPHUS SHOULD READ ZIZIPHUS (=ZIZYPHUS)

Anamorph Index

Asperisporium

ADD *caricae* (presumed) *caricae*

AFTER *Asperisporium*, ADD THE GENERIC NAME *Asteroma*

Asteroma

ADD *subadians* *brunneola*

Asteromella

- ADD *angustifoliorum* *angustifoliorum*
 ADD *effigurata* *fraxini*
 ADD *fraxini* *effigurata*

Cercospora

- AFTER *cerasella*, ADD (= *circumscissa*)
 ADD *circumscissa* (= *cerasella*) *cerasella*

Cercosporidium

- AFTER *magnoliae*, ADD (= *Phaeoisariopsis* m.).

AFTER *Cladosporium*, ADD THE GENERIC NAME *Chypeispora**Chypeispora*

- ADD *angustifolium* *angustifolium*

Coniothyrium

- ADD *sabalis* *sabalis*

Diplodina

- AFTER *Diplodina*, ADD THE GENERIC NAME *Discula*

*Discula*UNDER *Discula*, ADD

- nervisequa* *veneta*
umbrinella *errabunda*

Lecanosticta

- AFTER *Lecanosticta*, ADD THE GENERIC NAME *Marssonina*

Marssonina

- ADD *fraxini* *effigurata*

Phaeoisariopsis

- ADD *magnoliae* (= *Cercosporidium* m.) *milleri*

Phyllosticta

- ADD *fraxini* *fraxinicola*
 ADD sp. *mandshurica*

Pseudocercospora

- ADD *marasasii* *marasasii*

Pseudocercospora

- ADD *capsellae* *capsellae*

Septoria

- ADD *nilgiensis* *artemisiae*

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MELAMPILIDIUM METABOLUM BELONGS IN BACTROSPORA

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ABSTRACT: *Melampilidium metabolum* is referred to the genus *Bactrospora*. It is a corticolous, Indo-Pacific species.

The generic name *Melampilidium* was introduced by Stirton (1875) based on the species *M. amphorodes* (Stirton) Stirton from the basionym *Lecidea amphorodes* Stirton. Accordingly with Galloway (1985), an earlier taxon, *Melaspilea metabola* Nyl. from New Caledonia, was shown by Müller Argoviensis (1894) to be conspecific with *L. amphorodes* and he made the combination *Melampilidium metabolum* (Nyl.) Müll. Arg.

Examination of the type material of *Melaspilea metabola* Nyl. has shown that it belongs to *Bactrospora*, due to the following main features:

1. Excipulum composed of a plectenchyma of conglomerate, thick-walled hyphae, with strongly gelatinized walls, not easily discerned.
2. Hymenium colourless, without hymenial strand of excipular tissue intruding between the paraphysoids (ascostromata multiascal, monocarpocentral, sensu Tehler 1990: 2465).
3. Paraphysoids dichotomously branched, with little or no anastomosis and loosely interlaced in the hymenium, and much longer than the asci.
4. Asci bitunicate, easily separated from ascogenous hyphae and often broken. Exoascus thin and refringent. Endoascus slightly hemiamyloid (K/I). The apical apparatus of the asci consists of a conspicuous ring, I + pink and K/I+ blue,

around basal part of a small oculus, without apical nasse (*Bactrospora*-type, Torrente & Egea 1989: 32).

5. Ascospores cylindrical, without a gelatinous sheath, not brown when old, constricted at one or more septa, cells usually wider than longer. These ascospores are like the *Homalotropa*-type (sensu Egea & Torrente 1993: 214) but are muriform at maturity.

Bactrospora Massal.

Ric. Aut. Lich. 133 (1852). Type species: *Bactrospora dryina* (Ach.) Massal.

Scolecactis Clements, *Gen. Fungi* 147 (1907). Type species: *S. myriadea* (Fée) Clements (= *Lecidea myriadea* Fée).

Melampilidium Stirton, *J. Linn. Soc. Lond. Bot.* 14 (1875). Type species: *Melampilidium amphorodes* (Stirton) Stirton (= *Lecidea amphorodes* Stirton).

Lecanactis Sect. *Bacidiactis* Vainio, *Ann. Acad. Sci. Fenn., Ser. A*, 6: 141 (1915). Type species: *Lecanactis* (*Bacidiactis*) *denticulata* Vainio.

Bactrospora metabola (Nyl.) Egea & Torrente comb. nov.

Figures 1-8

Melaspilea metabola Nyl., *Bull. Soc. Linn. Normandie*, Ser. 2, 2: 69 (1868).- *Melampilidium metabolum* (Nyl.) Müll. Arg., *Bull. Herb. Boissier* 2, App 1: 79 (1894). Type: Nova Caledonia, Lifu, Layalti, 1864, Thiébaud (H-NYL 4907, lectotype selected here; H-NYL 4908, 4909, isolectotypes).

Lecidea amphorodes Stirton, *Rep. Trans. Glasgow Soc. Field Nat.*, 1: 19 (1873).- *Melaspilea amphorodes* (Stirton) Stirton, *Trans. Proc. N. Z. Ins.*, 6: 238 (1874).- *Melampilidium amphorodes* (Stirton) Stirton, *J. Linn. Soc. Lond. Bot.* 14 (1875). Type: New Zealand, Wellington, Tinakori Hills, 1873, J. Baughan (BM, lectotype not seen).

Thallus crustose, continuous to areolate, whitish or greyish, with a yellowish tinge, thin, mostly epiphloeodal, prothallus sometimes forming a thin black or dark brown irregular border around the thallus. In section up to 300 μ m, ecorticate and without a well differentiated medulla; I+ reddish, K/I+ deep blue. Photobiont probably *Trentepohlia*.

Ascomata apothecioid, black to brown-black, scattered, epruinose, at first immersed or subimmersed in the substratum, but soon becoming adnate or sessile with more or less constricted base, roundish or somewhat irregular in outline, 0.3-1.1 mm diam., concave to plane with a conspicuous margin, but becoming convex and immarginate with age. Excipulum dark red-brown to carbonaceous, well-developed, up to 50 μ m wide laterally, open below the subhymenium; I+ reddish, K/I+ deep blue. Hymenium 150-200 μ m, I+ reddish, K/I+ pale blue. Subhymenium pale brown, 100-125 μ m, I+ red-



Figures 1-8 *Bactrospora metabola*: 1. Habit; 2. Cross section of ascomata; 3. Habit; 4. Ascospores; 5. Young asci and broken ascospores; 6. Broken asci (mounted in K/I); 7-8. Asci with young transeptate ascospores. Scales: 1, 3 = 1 cm; 2 = 100 μ m; 4-8 = 20 μ m. Figures 1-2, 4-8 lectotype; 3 H-NYL 4926.

dish, K/I+ deep blue. Paraphysoids dichotomously branched, with little or no anastomosis and loosely interlaced in the hymenium, up to 2 μm wide. Apical cells of paraphysoids not thickened, richly branched and anastomosing, forming a reticulate dark brown pseudoepithecium. Asci pyriform, 110-135 x 37-45 μm , of *Bactrospora*-type. Ascospores (55-)65-95 x 8-13(-14) μm , of *Homalotropa*-type but muriform at maturity, with up to 27 transversal septa.

Pycnidia immersed or subimmersed in the thallus, globose, up to c. 200 μm tall and 225 μm wide, with walls dark brown or carbonaceous at the upper part and colourless in the inner part; K+ green-brown. Conidia 12-18 x 1 μm , filiform and curved.

Chemistry: Thallus K-, C-, PD-. No substances detected by TLC.

Distribution and habitat: *Bactrospora metabola* is a Indo-Pacific species, at present known from Andaman Island (India), New Caledonia, New Zealand, and Papua New Guinea (in Laing Island; Sérusiaux com. litt). Corticolous.

Notes: This taxon is easily distinguished from other *Bactrospora* species by its pyriform, wide asci, and its muriform ascospores.

In Galloway (1985) and Awasthi (1991) the ascospores are 4-6-8 per ascus and 75-110 x 9-14 μm . In the types investigated, we usually found shorter ascospores, and 8 per ascus.

Additional specimens examined: **INDIA**: Insula Andaman, 1867, S. Kurz (H-NYL 4911).- **NEW ZEALANDA**: 1867, Knight (H-NYL 4926).

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LLIMONAEA FLEXUOSA, A NEW SPECIES FROM CABO VERDE (OPEGRAPHALES, LICHENIZED ASCOMYCOTINA)

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ABSTRACT: The Capeverdean *Llimonaea flexuosa* is described as a new species, characterized by its dendroid to flexuose ascomata, dark brown ascospores and the C+ reddish thallus.

The genus *Llimonaea* Egea & Torrente was described for the single species *Ll. occulta* (Torrente & Egea 1991), at present known from Spain, Portugal and Morocco. It was included in the order Opegraphales (= Arthoniales) and is defined by the following main characters: cortex inconspicuous or often with mixed and intertwined hyphae, ascomata with thalline margin and a thick, dark brown proper exciple, paraphysoids branched and anastomosing, asci of the *Grumulosa*-type (Torrente & Egea 1989), ascospores hyaline but becoming brown when old, and conidia filiform and curved.

A second species of this genus has been identified from material collected by one of us (B.M.) on the Cape Verde Islands, growing in dry-maritime and coastal saxicolous ombrophobous communities.

Llimonaea flexuosa Egea, Torrente & Mies

Figures 1-9

Thallus crustaceus, epilithicus, albus vel cremeoalbus, ecorticatus. Ascomata primum immersa et dendritico-ramosae, deinde adnata et lirellata, 1-5 x 0.2-0.7 mm, flexuosa,

marginibus thallinus instructa. Excipulum fusco-nigrum. Paraphysoides ramosae et anastomosantes. Asci fissitunicati, cylindrici-clavate, octospori, 70-90 x 16-20 μm . Ascospores fusiformes, 21-36 x 4-6 μm , 5-9 septatae, primum incolratae, demum brunneae, halonatae, septis incrassatis. Pycnidia immersa; pycnosporae filiformis, curvatae, 13-18 x 1 μm .

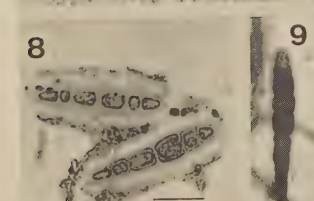
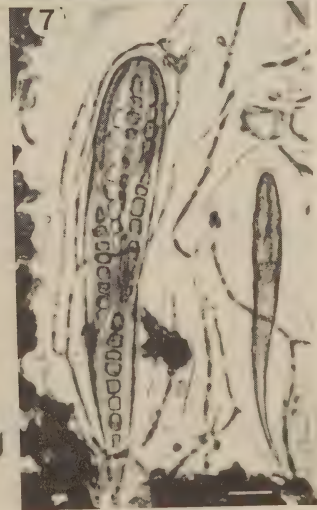
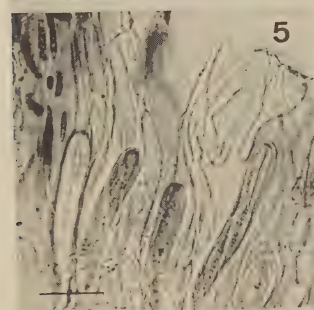
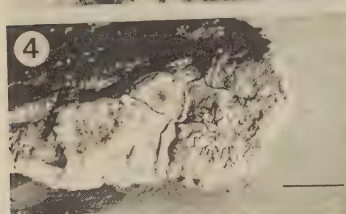
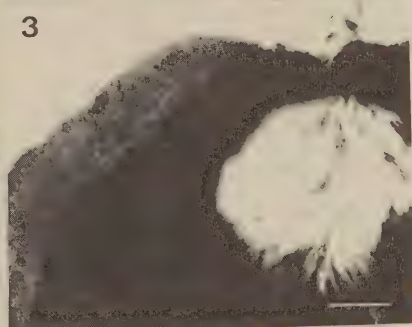
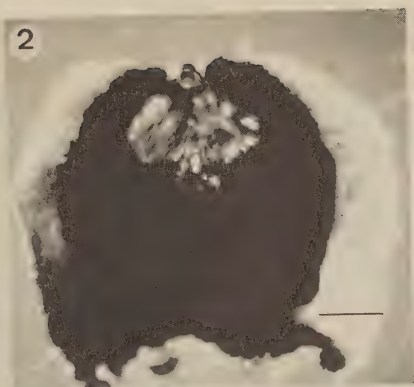
Type: Cape Verde Islands, Boa Vista, Mt. Gude/Passarao, ombrophobous, shady overhangs, above tuffets and soil, 250 m, expos. N, 9.11.1987, B. Mies 616c, CV-3520 (MUB, holotype; herb. Mies, herb. Lumbsch, isotype).

Thallus crustose, white to creamy-white, effuse, continuous to rimose-cracked, with smooth or slightly farinose surface, surrounded by a thin, smooth and black prothallus. In section, up to 400 μm high, ecorticate and with a distinct medulla, totally interspersed with granules and crystals of unknown nature, insoluble in K or H_2SO_4 . Epinecral layer up to 30 μm , with some scattered hyphae. Medulla white and cretaceous, but in some areas with a thin lower black-brown medulla. Algae *Trentepohlia*-like.

Ascomata at first dendroid and immersed, later lirelliform and elevated. Lirellae 1-5 x 0.2-0.7 mm, flexuous, simple or slightly branched, scattered or aggregated, adnate without constricted base. Thalline margin thin, smooth or granulose, becoming inapparent. Proper margin thick, smooth and glossy black, overtopping and hiding the hymenium except for a very narrow slit. Proper exciple up to 80 μm thick and dark brown, composed by a plechtenchima of conglutinated hyphae with strongly gelatinized hyphal walls, and the individual hyphae not easily discerned. Hypothecium carbonaceous or dark brown, extending down to the substrate. Hymenium hyaline, 140-200 μm , I+ reddish, K/I+ pale blue. Subhymenium up to 50 μm , pale brown. Paraphysoids richly branched and anastomosing, 1-1.5 μm wide, with apical cells usually smooth and hyaline and not or slightly thickened, embedded in a brown granular pigmentation (insoluble in K), and forming a dark brown pseudo-epithecium. Asci cylindro-clavate, 78-90 x 16-20 μm , of *Grumulosa*-type (Torrente & Egea 1989). Ascospores fusiform, 21-36 x 4-6 μm , 5-7(-9) septate, hyaline when young and brown at maturity, thick walled, with thickened septa and with gelatinous sheath.

Pycnidia punctiform, immersed or subimmersed, unilocular, 150 μm tall and 125 μm wide, with reddish brown pycnidial walls. Conidia 13-18 x 1 μm , filiform and curved.

Figures 1-9 *Llimonaea flexuosa* (holotype): 1. Habit; 2. Cross section of ascomata under polarized light; 3. Cross section of ascomata. Note the thalline margin with algae and the thick proper exciple; 4. Detail of young ascomata; 5. Hymenium after squash; 6-7. Young and mature asci; 8-9. Ascospores variability. Scales: 1, 4 = 4 mm; 2 = 100 μm ; 3, 5 = 50 μm ; 6-9 = 10 μm . Figures 5-9 mounted in K/I.



Chemistry: Thallus and medulla K- or K+ yellowish, C+ reddish, KC-, PD-; erythrin and lecanoric/gyrophoric acids detected by TLC.

Distribution and habitat: The species grows on the overhanging faces of volcanic rocks in the coastal zone of the Cape Verde Islands (Mies 1989). The geology of the localities contains a mixture of basaltic or lava outcrops, intermingled with tuffits and volcanic ashes. Other lichens associated with this new species are *Bacidia thyrsodes*, *Caloplaca marina*, *C. scoriophila*, *Diploicia subcanescens*, *Dirina* spp., *Gorgadesia mira*, *Lecanographa grumulosa*, *L. dialeuca*, *Opegrapha* spp., *Roccella canariensis*, *R. tuberculata* agg., *Sclerophyton* sp. and more. The probable altitudinal occurrence of *Llimonaea flexuosa* ranges from 50 to 450 m above sea level. The localities are reached by salinic sea foam, blown by the NE trade-winds. The salinic coastal conditions of this volcanic archipelago have provided a multitude of ecological niches for adapted *Trentepohlia*-containing lichen ancestor species to evolve a multitude of endemic forms since the Miocene.

Notes: In the dicussion by Torrente & Egea (1991), *Llimonaea* was compared with some genera of the families Opegraphaceae and Roccellaceae. According with our present knowledge, some species of *Sclerophyton* (*S. californicum*, *S. circumscriptum*), are the closest relatives of *Llimonaea*. In all these taxa the type of ascospores, paraphysoids and conidia are similar. In *Sclerophyton*, like *Llimonaea*, the cortex is inconspicuous to well developed and, in *S. californicum* especially, the ascomata are surrounded by a thalline margin. The main difference between these genera is found in the anatomy of the excipulum propeum: that in *Sclerophyton* is inconspicuous to very thin vs. the very thick one in *Llimonaea*.

Llimonaea flexuosa is distinguished from *Ll. occulta* by its mainly ecorticate thallus, its flexuose, lirellate ascomata with a slit-like disc and its dark-brown ascospores at maturity. In *Ll. occulta* the thallus is mainly corticate, the ascomata are lirellate to roundish with spanded disc at maturity and the ascospores become brown only when old.

Additional specimen examined: Cape Verde Islands: Santiago, W of Mt. Graciosa, N of Tarrafal, on rock boulders, 200 m, expos. N, 15.9.1988, B. Mies 835/836e, CV-4004 (M).

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MYCOTAXON

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MYXOMYCETES FROM CHINA III:

Description of a new species, *Cribraria media*, and discussion of the relationship between *Cribraria* and *Dictydium*

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ABSTRACT: This paper has been prepared to describe a new myxomycete, *Cribraria media* sp. nov., which appears to be intermediate between *Cribraria* and *Dictydium*. The relationship between of these two genera, based on the characteristics of the new species and those of allied species, is discussed.

In the taxonomic treatment of myxomycetes, the establishment of new taxa and understanding the extent of variation within already described taxa are undoubtedly important. However, the study of an intermediate form and its related problems in the field of myxomycete systematics is often something of concern to taxonomists. Although taxonomists can find themselves in a dilemma when an intermediate form shows characteristics of no clear separations, this fact also reflects a link in a chain of species. The specimen collected by Huang N. L. (no. 78801) from Fujian is such an intermediate form, linking the genera *Cribraria* and *Dictydium*. It is regarded as a new species mainly because of its intermediate characteristics and accordingly is named *Cribraria media* H.-z. Li et Y. Li. It is described as follows:

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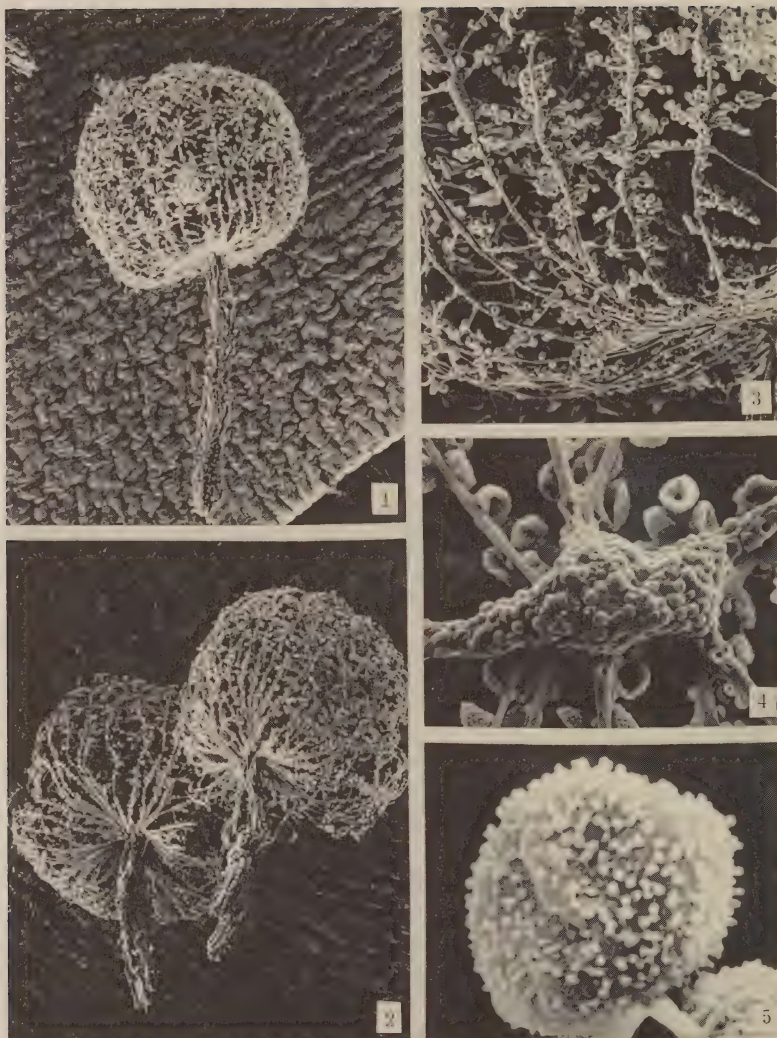


Plate I *Cribraria media* H.-z. Li & Y. li sp. nov.

1. Sporangium (x 70) 2. Two sporangia (x 80) 3. Detail of net (x 300)
4. Node (x 1500) 5. Spore (x 10000)

Cribraria media H.-z. Li et Y. Li sp. nov. Plate I, Figs I, II, III

Sporangia gregaria, dense gregaria ad rubcaespitose, in partes magnas consociata, stipitata erecta, vel leviter nutantia, globosae, sordidus olivaceus-brunneus, 0.5-1 mm diam., 1.1-2.5 mm alta. Peridium evanescens, basi disciform, saepe persistenti, costatis fere 30 ex apice stipitis, radiantibus, intrequenter furcatis et connexis ramis transversis filis tenuis reticulo irregulari, pauciora apice libris, inferne nodis expansis, supra sensim incrassatis apparenter, prominentia semisphaericus, costatis et nodis retis granulis plasmodicis, 1-1.5 μ m diam., impletis. Stipes atrobrunneus, robustum, sursum attenuatum, longitudine 2.5-3 μ m diam. Sporangii, fibro striatum, saepe tortum, Hypothallus inconspicuus; sporae in massa sordidus olivaceobrunneus, luce transmissa dilute fulvus, globosae, verruculosae, 5.5-7 μ m diam. Plasmodium ignotum.

Sporangia gregarious, closely gregarious to subcaespitose, sometimes forming large colonies, stipitate erect or slightly nodding, globose, sordid olive-brown, 0.5-1 mm in diameter, total height 1.1-2.5 mm. Peridium fugacious, cup usually lacking, or sometimes represented by a small basal disk, lower portion consisting of 30 or more ribs radiating from the stipe, these often branched, and with stout longitudinal ribs connected by delicate transverse bands, the upper part forming a network, free ends, nodes expanded in lower, but thickened upward, convex, hemispherical ribs and nodes filled with dictydine granules, about 1-1.5 μ m in diameter. Stalk dark brown, strongly tapering upward, 2.5-3 times the diameter of the sporangium, fibroid, usually twisted, hypothallus inconspicuous. Spores brown in mass, pale brownish yellow by transmitted light, globose, warted, 5.5-7 μ m in diameter. Plasmodium unknown.

Type: Fujian, Sanming, Taijiang on decaying coniferous wood, Aug. 1978, Huang Nian-lai 78801 (HMAS 59510).

The sporangia of this species are sordid olive-brown, with a net at the upper part of the peridium, convex nodes and fine lines of net. The Dictydium-like shape of the lower part makes it unlike any other species of *Cribraria*. As such, this

species is an intermediate form between *Cribraria* and *Dictydium*. Previous discussions of the relationship of the two genera have centered on *Dictydium mirabile* (Rost.) Meylan. Thus, in order to consider the relationship between the two genera, it is necessary to trace their taxonomic history. The genus *Dictydium* was established by Schrader in 1797, on the basis of the shape of *Cribraria* and the absence of a cup. It was further developed in 1875 and a new genus (*Heterodictyon*) was accordingly proposed by Rostafiski. The type specimen of the new genus was *H. mirabile* Rost. Rostafiski pointed out that the species was characterized by the presence of ribs in the lower part of the sporangium as well as a net of the type found in *Cribraria* in the upper part. In 1892, however, Masee grouped *Heterodictyon* with *Cribraria* in his monograph, and at the same time transferred the species to *Cribraria* as *C. mirabilis* (Rost) Mass. After that, in 1901 Jahn described a variety, *Dictydium umbilicatum* var. *anomalum* Jahn, with stiff stipes, long sporangia, no cups, and a netted peridium with a silver lustre. He studied this "species" for years and thought it was not out of the scope of *Dictydium umbilicatum* Schrad., as set up by Schrader. Thus, he regarded it as a variety. Then, Meylon (1908) elevated it to the rank of species as *Dictydium amomalum* (Jahn). Meylan and thought it might be *Heterodictyon mirabile* Rost. as named by Rostafinski. In 1911, G. Lister grouped this species of Meylon with her variety - *Dictydium cancellatum* var. *alpinum* G. Lister. The concept was followed until 1925 in the third edition of Lister's monograph, *A Monograph of Mycetozoa* as revised by his daughter. In 1932, Meylan republished *D. cancellatum* var. *alpinum* G. Lister as *D. mirabile* (Rost) Meylan. In 1962, Nannenga-Bremekamp combined *Dictydium* and *Cribraria* mainly on the basis of the alterations of this species in history, and the plasmodic granules present in both *Cribraria* and *Dictydium*. Therefore, she regrouped this species with *Cribraria mirabilis* (Rost.) Masee. In the meantime, she regarded *Dictydium rutilum* G. Lister, which was similar to this species, as *Cribraria rutila* (G. Lister) nov. comb. The concept was adopted by Nannenga-Bremekamp's students and followers but objected to by Martin and Alexopoulos (1969), who still recognized the existence of *Dictydium* and agreed with Meylan on *Dictydium mirabile* (Rost.) Meylan, i. e.,

Dictydium mirabile (Rost.) Meylan. The same taxonomic treatment was also adopted in 7th edition of Ainsworth and Bisby's Dictionary of the Fungi (1983), in which the authors admitted the existence of *Dictydium* and stated that it has three species. Although the disputes augered around this species have been so sharp and have touched upon the combination and separation of the two genera, so far there is no dispute about the existence of *Dictydium mirabile* as a distinct species. To sum up, its characteristics are mainly as follows: fuscous sporangia usually with violet-brown tone of colour similar to that of the reddish-brown or violet-brown of *Dictydium*; peridium net-like in the upper part, but with no thick nodes (mark of emphasis by authors), and the ribs wide in the lower part (note: no connection of fine horizontal lines); The sporangia appear reddish-brown when spores are in mass (also having the colour tone of *Dictydium*) If comparing the illustrations from Martin and Alexopoulos (1969) and Nannenga-Bremekamp (1974), in which the two genera are combined, we find that this species is clearly similar to *Dictydium* in appearance. From a systematic point of view, it may be stated that *Dictydium mirabile* (Rost.) Meylan is an intermediate form between *Dictydium* and *Cribraria*, although obviously closer to the former. Among the three species in *Dictydium*, there are *Dictydium cancellatum* (Batsch) Macbr., (which has explicit features,) *Dictydium mirabile* (Rost.) Meylan (discussed above), as well as *D. rutila* G. Lister. As we know, *D. rutila* G. Lister is known only from Australia, but it is closer to *Dictydium* as compared with *Dictydium mirabile* (Rost.) Meylan from its features: a peridial net consisting of 14-16 dark brown ribs connected by a few delicate transverse threads (note: with delicate transverse threads), and with net shape in the upper part (whether or not nodes exist can not be determined from the illustration). Nannenga-Bremekamp grouped it with *Cribraria*, but previously published illustrations clearly showed *Dictydium*-like sporangia. All of this shows that there are common characteristics among the three species of *Dictydium* which are independent of *Cribraria* but show their relationship with *Cribraria* through *Dictydium mirabile* (Rost.) Meylan. The question might be asked as to whether or not there are any similar intermediates in *Cribraria*. The new species,

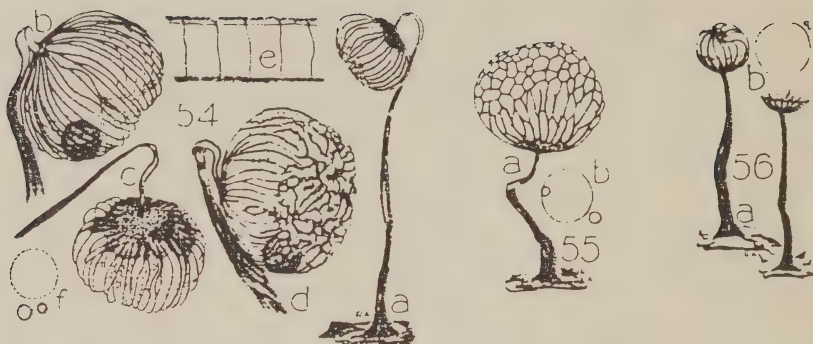


Fig. I 54. *Dictydium cancellatum* (Batsch) Macbr. a. Sporangium, b. Same without cup, c. Same, with cup, d. Same, with cribrarioid net above, e. Detail of net, f. Spore and dictydine granules 55. *Dictydium mirabile* (Rost.) Meylan a. Sporangium b. Spore and dictydine granule 56. *Dictydium rutilum* G. Lister a. Two sporangia b. Spore and dictydine granules (Redrawn from Martin & Alexopoulos, 1969)

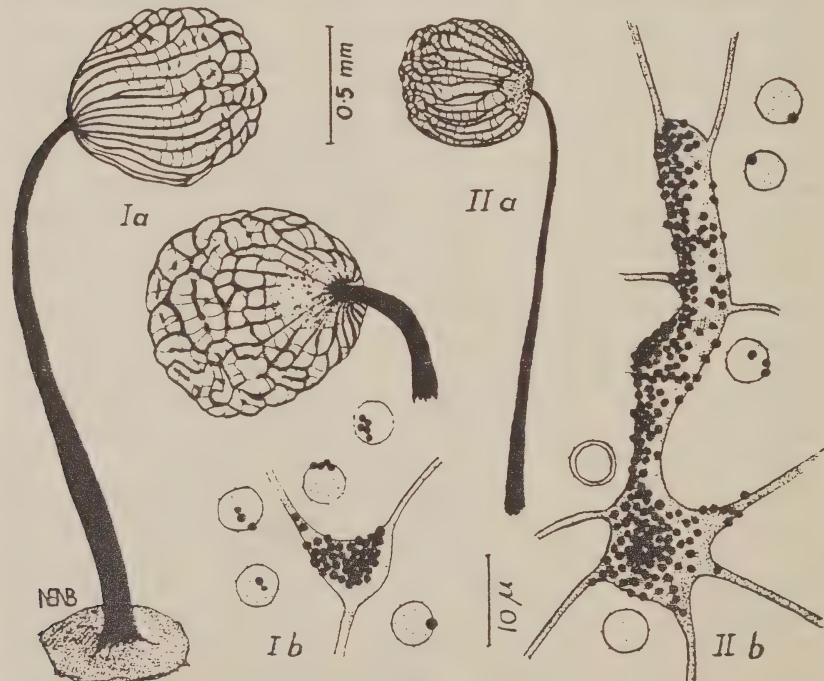


Fig. II *Cribaria mirabilis* (Rost.) Massee. I (2132): a, two sporangia; b, spores and a node of the peridial net. *Cribaria cancellata* (Batsch.) nov. comb. var. *fusca* (G. Lister) nov. comb. II (4031): a, sporangium; b, pericidal rib ending in node, and spores. The black dots in Ib and IIb are 'dictydine' granules. Corresponding parts drawn to the same scale. (Redrawn from N. E. Nannenga Bremekamp 1974)

Cribraria media, would appear to be just such a typical representative.

The sporangia and spore pill of *C. media* species appear to be slightly dull olive-brown or yellow-brown. Like most species of *Cribraria*, except *C. violacea* Rex and *C. lepida* Meylan, it has a brown-yellow colour tone. The authors of the present paper think that *C. violacea* And *C. lepida* represent a separate line of evolution, which will be discussed in a future paper. The ribs of the peridial net in *C. media* are connected by clear fine horizontal lines in the lower half, completely like *Dictydium* (but the colour tone is different), with spreading net nodes on the ribs upwards, net shape in the upper half with net nodes connected by the fine net line, free ends present, nodes convex rather than plain, which distinguishes this species, from other intermediate types such as *C. splendens* (Schrad.) Pers., whose cup is replaced with 8-15 ribs (let not linked by fine lines), shape of net in the upper part but flat or slightly thick nodes, flat net lines, obviously different from *Dictydium*. Other examples such as *C. atrofusca* Martin & Lovejoy and *C. personii* Nann.-Brem., have thick or slightly thicker net nodes in the upper half part of the net, a cup in the lower half, thicker and longitudinal lines and fine concentric corrugations which represent an evolutionary trend of fine horizontal lines between two ribs during the stage development. Thus, *Cribraria media* H.-z. Li et Y. Li is a distinct independent species, and also a special one linking *Cribraria* and *Dictydium*, although closer to the former.

In order to investigate the evolution of organisms, "it is in the first place to make a distinction between two basic processes: origin and development" (Chen shi xiang: "The evolutionism and taxonomy", Science Press, Beijing 1981), but of the two processes, normally it is more difficult to study the origin. For example scholars such as Martin and Alexopoulos (1969) and Zhou Z. H. (1981) have thought that *Cribraria* should be regarded as close to *Enteridium* and probably developed from an ancestor of *Echinostelium* by inference. But it is even more difficult to study the development of *Cribraria*. To account for this difficulty there are three reasons: lack of convincing evidence provided

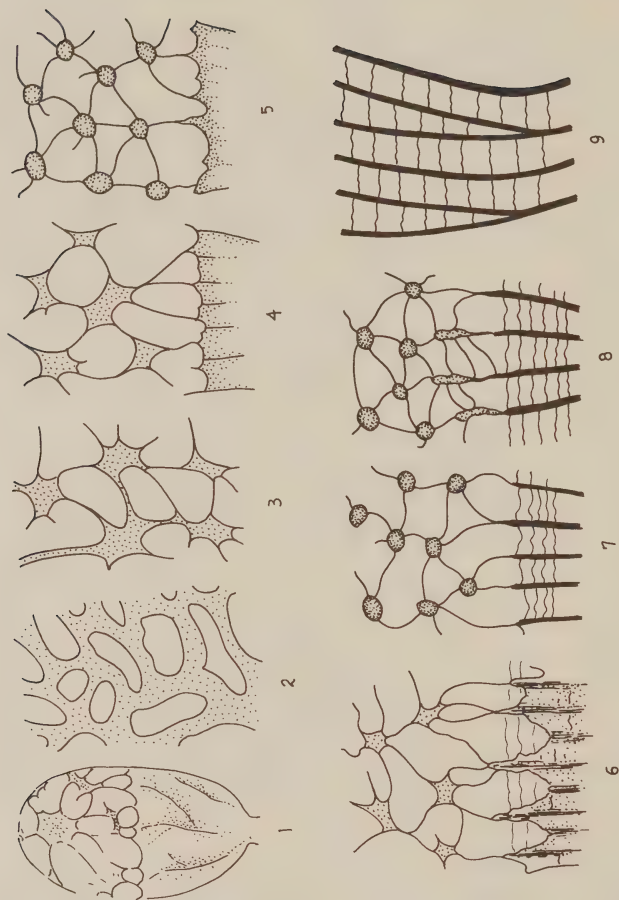


Fig. III 1. *Lindbladia tubulina* Fries 2. *Cribraria argillacea* (Pers.) Pers. 3. *Cribraria oregana* H. C. Gilbert 4. A few species *Cribraria* 5. A few species of *Cribraria* 6. *Cribraria atrofusca* Martin & Lovejoy 7. *Cribraria personii* Nann.-Brem. 8. *Cribraria media* H.-z. Li & Y. Li 9. *Dictydium cancellatum* (Batsch) Macbr.

by fossil data of myxomycetes up to now; confusing phenomena of the evolution of taxa, and the lack of related data from researches. From the point of comparable morphology, one of the authors (Li Y. 1981) once tried to explain its trend of evolution with the discussion of the stage development in this family, and thought that *Lindbladia* represents a low stage of development. However, *Cribraria* has developed to a relatively high stage and *Dictydium* reflects an even higher level. Now the new species: *Cribraria media* H.-z. Li et Y. Li becomes a convincing evidence for this inference. No matter how many species or genera there are and no matter how different the types are in the family *Cribrariaceae*, there are two common features: peridium-shaped net and plasmodic granules which show relative marks of the same sort. Moreover, three classifications: *Lindbladia*, *Cribraria* and *Dictydium* appear due to differences in basic features. Just in view of *Cribraria* and *Dictydium*, a comparison will be made in the stage development:

1. Appearance of fructification: a range from simplicity to complexity is reflected in the differentiation of sessile or short-stipitate sporangia to significant differentiation in stipitate sporangia; *C. argillacea* (Pers.) Pers., which is close to *Lindbladid*, appears spherical with sessile or only short stipitate, sporangia and most species of *Cribraria* and *Dictydium* have sporangia with long stalks.

2. Structure of the fructification:

- (1) Hypothallus: the range from adequate to inadequate differentiation during the formation of the fructification is reflected in thick layer of hypothallus retaining the net veins of plasmodium (*C. argillacea* (Pers.) Pers.) to the thin or indistinct hypothallus (the majority of species).

- (2) Net nodes and threads: *C. argillacea* (Pers.) Pers. is close to *Lindbladia* in having a thickened net shape in the upper part of peridium, where the unwithered rift begins to have net nodes, which have no clear differentiation from net lines, however. But most groups of flat nodes have definite net nodes connected by fine net lines, and then net nodes rise and form majority of groups of convex nodes. The regular, horizontal and fine lines on the toothlike projections as well as the cup in the lower part have begun to turn up among the more evolutionary groups such as *C.*

atrofusca Martin & Lovejoy and *C. personii* Nann.-Brem. The definite wide and longitudinal ribs connecting with fine horizontal lines are formed at the lower part of sporangia gradually, but with convex net nodes and fine net lines (*Cribraria media* H.-z. Li et Y. Li). *Dictydium* of higher level, however, becomes a connection between wide longitudinal ribs and fine horizontal lines completely. Its convex longitudinal ribs can be regarded as thickened nodes and horizontal lines can be regarded as connection lines among nodes. The mesh has evolved from an irregular shape to a regular square.

(3) Plasmodic granules: the distribution of plasmodic granules and the evolution of nodes have supplemented each other. *C. argillacea* (Pers.) Pers. with an obvious distribution is distinguished from *Lindbladia tubulina* Fries, with unclear distribution contained only in flat nodes and wide connecting lines (*C. oregans* Gilbert) - contained in flat nodes but not in net lines (majority of species with flat nodes) - contained fully in convex nodes but not in net lines (species of convex nodes) - contained only in longitudinal ribs but in fine horizontal lines (*Dictydium* majority). The distribution mentioned above shows the accumulative process of plasmodic granules. This is also similar to the distributional relationship of calcareous elements in the capillitium between *Badhamia* and *Physarium*.

3. Methods of spore release: the methods of releasing spores are in accordance with the above forms and characteristics. There are no meshes in the low grade groups that release spores by splitting away at the upper part until the peridium has meshes through which spores are released, at the same time keeping characteristics of releasing spores by splitting away (*C. argillacea* (Pers.) Pers.), however, the majority of *Cribraria* release spores through meshes completely, which on the one hand is helpful to the release of spores, and on the other hand prevents spores from releasing completely. It is more evolutionary advanced as compared with simply splitting away. As to *Dictydium*, due to its dense and regular meshes, it is more moderate in releasing spores than *Cribraria*. In the nature sporangia, part of the spore pill remains intact without any appreciable loss during a long time.

4. Habitat: Although the stage of nutrition and the stage of reproduction of myxomycetes are not always completed on the same basic substrate the trend from widespread to specific with respect to the ingestion from a large scope is reflected. For example, *Lindbladia* can emerge on many kinds of substrates. However, the majority of *Cribraria* and *Dictydium* emerge mainly on the dead wood of conifers.

Apparently, *C. argillacea* (Pers.) Pers. is linked to *Lindbladia*, whereas *C. media* is connected with *Dictydium*, and they form a whole. In particular, *C. media*'s characteristics of "no clear separation" reflect the state of continuity and discontinuity between *Cribraria* and *Dictydium*. As such It might be stated that this species is good material for studying this aspect of systematic mycology.

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中国之粘菌 III:

新种:中间筛菌兼论筛菌与灯笼菌的关系

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摘要: 本文描述了粘菌的一个新种: 中间筛菌 (*Cribraria media* H. Z. Li et Y. Li sp. nov.). 这个新种是筛菌属 *Cribraria* 和灯笼菌属 *Dictydium* 之间的过渡类型。根据新种及其相近种的特征, 作者讨论了这两个属之间的关系, 提出了系统学上的一些观点, 模式标本由中国科学院微生物研究所真菌标本室收藏。

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ACREMONIUM SECTION LICHENOIDEA SECTION NOV. AND PRONECTRIA OLIGOSPORA SPECIES NOV.

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ABSTRACT

Acremonium section Lichenoides sect. nov. is erected for nine lichenicolous species of Acremonium. Keys are provided to the sections of Acremonium and to the lichenicolous species of Acremonium. The Acremonium anamorph and the teleomorph of Pronectria oligospora sp. nov., found on Punctelia spp. are described. Acremonium rhabdosporum is the anamorph of Nectria rubefaciens. This species, found on Parmelia and Punctelia, is redescribed.

Key Words: Acremonium, Hypocreales, lichenicolous fungi, Nectria, Pronectria.

Frequently non lichenized fungi occur on lichens. They form a variety of mutualistic symbioses with their hosts ranging from parasitic to commensalistic to saprophytic (Hawksworth, 1988). Most species of lichenicolous (lichen-inhabiting) fungi are found almost exclusively on lichens; in some cases they belong to genera that also include fungi found elsewhere (Alstrup and Hawksworth, 1990). Lichenicolous fungi may be expected to be found wherever their host lichens occur. Many species have been described from Europe (Clauzade et al., 1990), Greenland (Alstrup and Hawksworth, 1990) and continental United States and Canada (Eagan 1987, 1989, 1990).

Hawksworth (1979) is the only study of lichenicolous hyphomycetes. He accepted 44 species in 23 genera. Clauzade et al. (1990) in their key to lichenicolous fungi have about 80 species in 50 genera of hyphomycetes. An additional 5 species and genera were described by Roux and Bellemère (1991).

According to Hawksworth (1979) four species of Acremonium Link: Fries have been found exclusively on lichens: Acremonium lichenicola W. Gams, Acremonium rhabdosporum W. Gams, Acremonium spegazzinii D. Hawksw. (based on Verticillium lichenicola Speg.) and Acremonium antarcticum (Speg.) D. Hawksw. Another species, A. strictum W. Gams, is not strictly lichenicolous. Teleomorphs were not known.

Three lichenicolous species of Acremonium have been described since 1979; two have been connected to teleomorphs. An Acremonium anamorph with ellipsoid conidia isolated from ascospores of Pronectria

santessonii (Lowen & D. Hawksw.) Lowen was discovered on Anaptychia runcinata (With.) Laundon in England (Lowen and Hawksworth, 1986). Acremonium pedatum Lowen occurring on Hypogymnia physodes (L.) Nyl. is the anamorph of Pronectria anisospora (Lowen) Lowen (Lowen, 1989). The third species, Acremonium psychrophilum Möller & Gams, was isolated from Turgidosculo complicatulo (Nyl.) J. & E. Kohlm. from the Antarctic. Acremonium psychrophilum, unlike the first two species, has branched conidiophores and chondroid hyphae. Chondroid hyphae have refractive wall thickenings that form tough leathery colonies. On the basis of these characters Möller & Gams (1993) placed A. psychrophilum in Acremonium sect. Gliomastix (Guéguen) W. Gams close to A. verruculosum W. Gams & Veenbaas-Rijks. Acremonium verruculosum was formerly classified in sect. Nectrioidea (Gams, 1971). Teleomorphs of section Gliomastix are unknown.

Gams (1971) included 82 species in Acremonium and recognized three sections: sect. Simplex W. Gams, sect. Gliomastix and sect. Nectrioidea W. Gams. In 1975 he changed the name, sect. Simplex to sect. Acremonium. This section is characterized by simple conidiophores and nonchondroid hyphae. Section Gliomastix has chondroid hyphae and colonies with a tough, leathery texture. The conidia in this section can be hyaline or encrusted with dark pigment. Section Nectrioidea has conidiophores that are broad and branched. Some of the included species, the anamorph of Nectria peziza (Tode: Fries) Fries for example, have chromophilic (deeply staining) granules at the base of the phialides. Section Nectrioidea included anamorphs of six species of Nectria (Fries) Fries (Hypocreales) sensu lato (see below). Gams (1971) placed Acremonium rhabdosporum and A. lichenicola among species of sect. Nectrioidea. The teleomorphs were unknown.

Morgan-Jones and Gams (1982) established two new sections of Acremonium. Acremonium sect. Albo-lanosa Morgan-Jones & W. Gams accommodates endophytic fungi that have slow-growing white to yellowish colonies, solitary phialides that are narrower at the base than the subtending hyphae, conidia that are hyaline and smooth walled, and anamorphs in the Clavicipitaceae. Acremonium sect. Chaetomioides Morgan-Jones & W. Gams was erected for anamorphs of Chaetomiaceae that have white, yellowish or olivaceous rather fast-growing colonies, short-aculeate (pointed) to lagenform (flask-shaped) phialides and dacryoid (tear-shaped) conidia with truncate bases. Some of the taxa can only be determined by their teleomorphs.

Other members of the Hypocreales including species in the the genera Nectria sensu lato, Nectriella Nitschke in Fuckel and Pronectria Clements in Clements & Shear have anamorphs in the genus Acremonium. Nectria,

with over 600 described species, is a diverse genus of the Hypocreales. Rossman (1989) defined the genus in a strict sense based on the type species Nectria cinnabarina (Tode: Fr.) Fr. A result of her work is the recognition of segregations from Nectria. One such group of species, Nectria subg. Dialonectria Sacc. was formally recognized by Samuels, et al. (1991). A large part of Nectria remains heterogenous and is referred to herein as Nectria sensu lato.

Two recent collections of new species of Nectria sensu lato found on lichens have revealed Acremonium anamorphs, referred to herein as Acremonium species I (FIGS. J-L) and Acremonium species II (FIGS. M-O). The new species are not related to Nectria cinnabarina or to Nectria subg. Dialonectria. They are closer to species of Pronectria or Nectriopsis Maire. Differences from the Nectria cinnabarina-Group include ascomata with a simple perithecial wall anatomy that do not become red in potassium hydroxide and a connection to Acremonium anamorphs. The new species of Nectria will be described at a later date but the Acremonium anamorphs are included in the key to lichenicolous species of Acremonium.

Although Acremonium is a form genus, the lichenicolous species of Acremonium constitute a group that shares many characters in addition to morphology. They have in common slow-growing and pale orange cultures, unbranched phialidic conidiophores generally longer than 15 μm , elongate conidia with a L/W of greater than 2 and up to 7-8, and Nectria sensu lato or Pronectria teleomorphs. The known teleomorphs have in common, usually subglobose and setose ascomata, elongate ascospores and asci lacking an apical ring.

Most lichenicolous species of Acremonium do not fit well in Acremonium sect. Nectrioidea because they do not have branched conidiophores that are wavy below the tip or chromophilic granules at the base. They do not go into sect. Gliomastix because the cultures are not tough and they do not have chondroid hyphae. Section Acremonium is unacceptable even though the species have simple conidiophores because the phialides have wall thickenings. They are not endophytes in grasses as in sect. Albo-lanosa. And they do not have teleomorphs in the Chaetomiaceae as in sect. Chaetomioides. Because they have so many features in common and cannot be accommodated in the existing sections of Acremonium, the new section Lichenoides is erected for the lichen-inhabiting species.

Two species of Acremonium with teleomorphs are described herein in Acremonium sect. Lichenoides. The first has a teleomorph in the genus Pronectria. Pronectria, type species: P. lichenicola (Ces.) Clements in Clements & Shear, is a genus of primarily

lichenicolous species with immersed, red, orange, or pale-colored, fleshy perithecia, and hyaline, two-celled ascospores. Lichenicolous species of Nectriella were segregated into Pronectria by Lowen (1990). Pronectria oligospora is a new species found in lichens so far restricted to species of the genus Punctelia. An Acremonium anamorph with elongate conidia was obtained in pure culture from the growth of single ascospores.

The second species, Acremonium rhabdosporum is connected herein to Nectria rubefaciens Ellis & Everhart. This species is frequently found on foliose lichens on the bark of fallen branches. A teleomorph has not been previously reported for this species. The fungus is redescribed.

MATERIALS AND METHODS

Single ascospore isolations were made according to Lowen and Hawksworth (1986). Media used were corn meal agar with dextrose (CMD, Difco), corn meal agar (CMA, Difco) and CMD with a small amount of each of the antibiotics streptomycin sulfate, chloramphenicol, neomycin sulfate, and tetracycline hydrochloride (CMD+). Cultures were grown in 5 or 9 cm Petri dishes at ca 20°C in ambient light or 12 hour alternating near UV light plus cool white fluorescent on at 20°C and off at 10°C. The acid-alkali reaction was tested with 3% potassium hydroxide (KOH) followed by 100% lactic acid, lactophenol (L) or L cotton blue (LCB). LCB was made after Watling (1977). Measurements were made from specimens in water. At least five spores were measured per mount and at least 20 spores were measured per species. Colors were described according to Kornerup and Wanscher (1978) (K & W). Phase contrast microscopy enabled visualization of structures mounted in water or LCB that are obscure with light microscopy: guttules in ascospores, apical ring in immature asci, and periclinal thickening in conidiogenous cells. The length to width ratio of conidia and ascospores is expressed as L/W. Abbreviated literature citations follow (Lawrence et al., 1968). Dimensions and descriptions of Acremonium antarcticum, A. lichenicola, A. psychrophilum, A. spegazzinii, and A. strictum were taken from literature cited below and were not examined.

TAXONOMY

ACREMONIUM LINK: Fries, Mag. Ges. Naturf. Freunde, Berlin 3: 15. 1809; Systema 1: XLIV. 1821.
Lectotype: Acremonium alternatum Link (S.F. Gray).

KEY TO THE SECTIONS OF ACREMONIUM

1. Hyphae chondroid; colonies tough and leathery; conidia sometimes with dark encrusting pigment.....Sect. Gliomastix
1. Hyphae mostly thin-walled; colonies soft; conidia hyaline.....2
2. Conidiophores usually branched,

- chromophilic granules often present
at base.....Sect. Nectroidea
2. Conidiophores usually unbranched,
chromophilic granules absent.....3
3. Endophytes in grasses; teleomorphs in
Clavicipitaceae.....Sect. Albo-lanosa
3. Lifestyle, habitat, and teleomorphs
otherwise.....4
4. Thermophilic or coprophilus;
teleomorphs in Chaetomiaceae
.....Sect. Chaetomioides
4. Substrates and teleomorphs otherwise.....5
5. Phialides without wall thickenings;
substrate various; conidia
ellipsoid, $L/W < 2$ Sect. Acremonium
5. Phialides with wall thickenings;
substrate usually lichens;
conidia elongate, $L/W \geq 2$ Sect. Lichenoidea

SECTIONS OF ACREMONIUM

1. Sect. Acremonium W. Gams [as Simplex],
Cephalosporium-artige Schimmelpilze. p. 39. 1971
[as Acremonium, Trans. Brit. Mycol. Soc. 64: 389.
1975]; type species Acremonium strictum W. Gams.
2. Sect. Albo-lanosa Morgan-Jones & W. Gams, Mycotaxon
15: 312. 1982; type species Acremonium
coenophialum Morgan-Jones & W. Gams.
3. Sect. Chaetomioides Morgan-Jones & W. Gams, Mycotaxon
15: 317. 1982; type species Acremonium alabamense
Morgan-Jones.
4. Sect. Gliomastix (Guéguen) W. Gams, Cephalosporium-
artige Schimmelpilze p. 73. 1971; Bull. Soc. Mycol.
France 21: 240. 1905; type species Gliomastix
chartarum (Corda) Guéguen.
5. Sect. Lichenoidea Lowen, sect. nov.; type species
Acremonium anamorph of Pronectria oligospora Lowen.
6. Sect. Nectrioidea W. Gams, Cephalosporium-artige
Schimmelpilze. p. 100. 1971.; type species
Acremonium butyri (van Beyma) W. Gams,
Cephalosporium-artige Schimmelpilze. p. 126. 1971.
[designated in Trans. Brit. Mycol. Soc. 59: 519.
1972].

ACREMONIUM SECTION LICHENOIDEA LOWEN SECT. NOV.

Cultura lente crescens, pallidus vel aurantiacus; conidiophora non ramosa, plus quam 15 μ m longa, simplicia vel saepe pluries septata, apice phialidica; conidia elongata, saltem duplo longiora quam latiora. Teleomorphosis Nectriae aut Pronectriae; ascinata subglobosa, setosa; asci sine annulo, ascospora elongata. Habitat lichenes.
TYPUS: Acremonium anamorph of Pronectria oligospora.

Colony slow-growing, color pale or orange;
conidiophores unbranched, usually greater than 15 μ m long, continuous with conidiogenous cells, with basal septum only, to pluriseptate; conidiogenous cell phialidic; tip not flared; conidia elongate, L/W greater than 2, collecting in heads in liquid droplets,

appearing clear at first, usually becoming pale orange. Teleomorph Nectria sensu lato or Pronectria; ascomata usually subglobose and setose with simple wall structure; asci lacking annulus; ascospores elongate. Habitat: thallus of lichens.

The key that follows includes two species that do not belong in sect. Lichenoida. Acremonium psychrophilum, although lichenicolous, belongs in sect. Gliomastix as described. Acremonium strictum, a cosmopolitan species often isolated from soil and only occasionally found on lichens, is in sect. Acremonium. Following the key is a list of species, a description of Pronectria oligospora sp. nov. with the Acremonium anamorph and a redescription of Nectria rubefaciens and its anamorph Acremonium rhabdosporum.

KEY TO LICHENICOLOUS SPECIES OF ACREMONIUM

1. Conidia subcylindrical, averaging $\geq 12 \mu\text{m}$ long, L/W averaging > 4 2
1. Conidia ellipsoid or ovoid, averaging $\leq 12 \mu\text{m}$ long, L/W averaging ≤ 4 4
 2. Conidia averaging $\geq 3 \mu\text{m}$ wide; basal abscission scar prominent; conidiophore 1-septate at base; on Hypogymnia physodes on branch on tree; ascomata immersed, orange.....A. pedatum teleomorph Pronectria anisospora
 2. Conidia averaging $< 3 \mu\text{m}$ wide; basal abscission scar obscure; conidiophore 2- or more septate; usually on Parmelia or Punctelia on bark on ground; ascomata immersed or superficial, red or red-orange...3
3. Wall of conidia thickened at ends; ascomata superficial, red-orange, setose.....A. rhabdosporum teleomorph Nectria rubefaciens
3. Wall of conidia thin throughout; ascomata immersed, red, nonsetose.....Acremonium sp. teleomorph Pronectria oligospora
4. Conidiophores chondroid, branched at base; conidia $5.0\text{--}13.5 \times 2\text{--}2.5 \mu\text{m}$ A. psychrophilum
4. Conidiophores mostly thin-walled, branched or unbranched; conidia otherwise.....5
5. Conidiophores minutely verrucose.....6
5. Conidiophores smooth.....7
 6. Conidiophores unbranched; conidia smooth, $4\text{--}8 \times 2.5\text{--}4.0 \mu\text{m}$, with a protuberant, basal abscission scar; colony pink; Europe.....Acremonium sp. ...teleomorph Pronectria santessonii
 6. Conidiophores branched; conidia minutely verrucose, $4\text{--}6 \times 2\text{--}3 \mu\text{m}$, with an obscure basal abscission scar; colony white; Brazil.....A. spegazzinii

7. Conidia subcylindrical, 5.0-9.5 x 1.5-2.5 μm , becoming 1-septate; colony pinkish, becoming brownish yellow.....A. lichenicola
7. Conidia ellipsoid, mostly nonseptate; colony white to orange.....8
 8. Conidia in some collections sometimes becoming septate; U.S.A.; teleomorph species of nonstromatic Nectria; ascomata subglobose, setose.....9
 8. Conidia nonseptate; occurring in Europe or the Antarctic; teleomorph unknown.....10
9. Conidia constricted in middle, (5-)8.0-10.5(-20) x 1.6-3.0(-3.5) μm ; conidiophores (8-)14-25(-40) μm long; chlamydospores globose, 3.5-3.0 μm diam; ascomata brown, becoming violet in KOH.....Acremonium sp. I
9. Conidia unconstricted, (2-)3-8(-10) x 1.5-2.5(-3) μm ; conidiophores (10-)16-25(-30) μm long; chlamydospores absent; ascomata orange, unchanging in KOH.....Acremonium sp. II
10. Conidiogenous cells $\leq 20 \mu\text{m}$; conidia ellipsoid, 4.0-5.5(-6) x 1.5-2.5(-3), L/W 2.4; occurring on Caloplaca sp. from the Antarctic and Hypogymnia from Luxembourg A. antarcticum
10. Conidiogenous cells $> 20 \mu\text{m}$; conidia ovoid, 3.5-5.5 x 1-2, L/W 3.0; typically from soil, cosmopolitan,.....A. strictum

LICHENICOLOUS SPECIES OF ACREMONIUM

1. A. antarcticum (Speg.) D. Hawksw., Bull. Brit. Mus. (Nat. Hist.) Bot. Ser. 6(3): 192. 1979; Sporotrichum antarcticum Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 20: 416. 1910. Section Lichenoidea.
2. A. lichenicola W. Gams, Cephalosporium-artige Schimmelpilze. p. 134. 1971. Section Lichenoidea.
3. A. pedatum Lowen, Mem. New York Bot. Gard. 49: 248. 1989. Teleomorph: Pronectria anisospora (Lowen) Lowen. Section Lichenoidea.
4. A. psychrophilum C. Möller & W. Gams, Mycotaxon 48: 441-450. 1993. Section Gliomastix.
5. A. rhabdosporum W. Gams, Cephalosporium-artige Schimmelpilze. p. 136. 1971. Section Lichenoidea.
6. A. spegazzinii D. Hawksw., Bull. Brit. Mus. (Nat. Hist.) Bot. Ser. 6(3): 195. 1979; Verticillium lichenicola Speg., Bol. Acad. Nac. Ci. 11: 612 (234 of reprint). 1889 [as lichenicolum]; non Acremonium lichenicola W. Gams. Section Lichenoidea.
7. A. strictum W. Gams, Cephalosporium-artige Schimmelpilze. p. 42. 1971. Section Acremonium.

8. Acremonium anamorph of Pronectria oligospora Lowen & Rogerson in Lowen sp. nov. Section Lichenoidae.
9. Acremonium anamorph of Pronectria santessonii (Lowen & D. Hawksw.) Lowen, Lichenologist 18: 322. 1986. Section Lichenoidae.
10. Acremonium sp. I. Section Lichenoidae.
11. Acremonium sp. II. Section Lichenoidae.

PRONECTRIA OLIGOSPORA LOWEN & ROGERSON SP. NOV.

FIGS. A-D.

Ascomata globosa, 100-200 μm , immersa, solitaria vel gregaria, aurantiaca. Parietes 20 μm lati. Asci unitunicati, clavati, 32-50 X 6.5-10.0 μm bispori vel octospori. Ascospores ellipsoidae, 14-20 X 4-6 μm , 1-septatae; cellulisi inaequalibus, hyalinae, laeves, guttulate. Status anamorphicus: Acremonium sp.

HOLOTYPE: U.S.A. Connecticut: Litchfield County, 5 mi S of Canaan, on Parmelia rudecta Ach. [= Punctelia rudecta (Ach.) Krog], on moss covered rock in woods, 2 Nov 1959, C.T. Rogerson 59-53 (NY!; ISOTYPE, IMI!).

ETYMOLOGY: The specific epithet refers to the reduced number of ascospores in the ascus.

ANAMORPH: Acremonium sp.

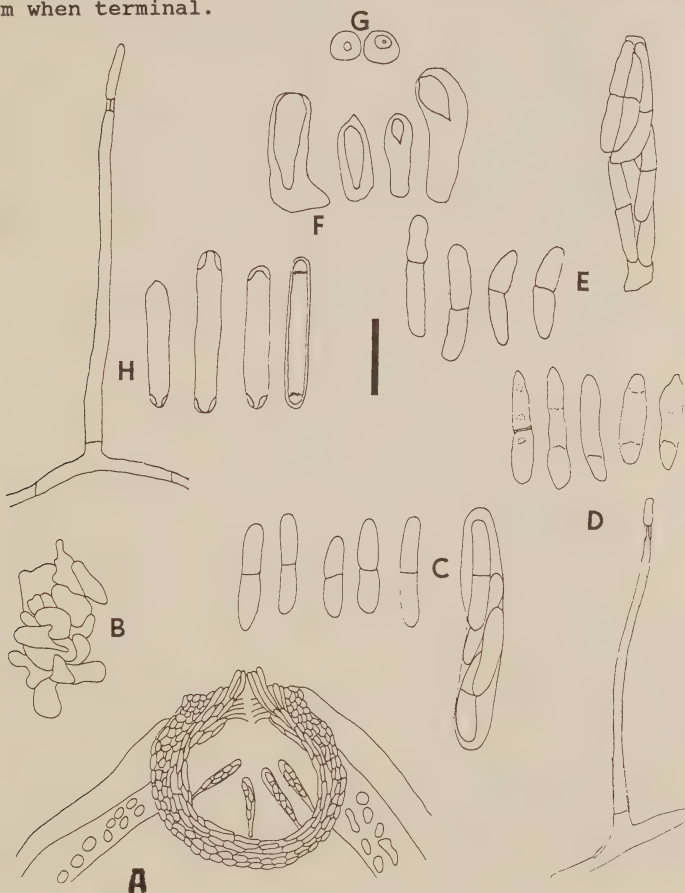
HABITAT: Thallus of Punctelia.

KNOWN DISTRIBUTION: France, U.S.A. (Connecticut, Georgia, New Jersey, New York, Missouri).

Ascomata subglobose, 100-200 μm diam, immersed in thallus, scattered or in groups of up to 20, nonstromatic, dark red, not changing color in KOH or sometimes becoming lighter in KOH, yellow in lactic acid. Nonsetose. Cells on surface epidermoid, 8 μm diam. Ascomatal wall 20 μm wide, of thick-walled angular to rounded cells; inner region 10 μm wide, of thin-walled elongate rectangular cells. Asci clavate, 32-50 x 6.5-10.0 μm ; apical ring absent; ascospores biseriate. Ascospores unequally ellipsoid, 14-20(-22) x (2.5-)4-6 μm , L/W 3.4; 1-septate; septum submedial, one cell slightly wider, curved, hyaline, smooth, 1-2 small guttules per cell; 2-8 maturing per ascus. Lichen thallus darker and discolored in presence of ascomata.

CHARACTERISTICS IN CULTURE. Ascospores germinating terminally and laterally from both cells. Colonies grown 7 da, 20°C light, 10°C dark. CMD: 5 mm diam, pinkish. Colonies filling the Petri dish in 3 months; aerial mycelium scant, of erect, parallel conidiophores; central raised knob 2-10 mm, pale orange; distal area whitish, translucent; margin uneven; reverse slightly darker. Conidial production visible after 7 da. Conidiophores semimacronematous, (21-)32-43(-80) μm long x 3 μm at base, tapering to 1.5 at tip, perpendicular to subtending hypha, unbranched, hyaline, smooth, 1- or 2-septate, terminating in a single conidiogenous cell; basal septum 1.5 μm from subtending hypha; tip of phialide with visible periclinal thickening, not flared.

Conidia elongate-cylindrical, (11-)15.5-19.0(-21.) $\times$ 1.5-2.5(-3.5) μm , L/W 9.0; with or without a slightly protuberant, 1 μm wide, basal abscission scar, unicellular, straight, smooth, hyaline; wall thin throughout; guttules sometimes in each end; aggregating in hyaline droplet of liquid at tip of phialide; droplets becoming confluent, slimy, pale orange. Chlamydospores subglobose, 5-7 μm diam when intercalary, 10 μm when terminal.



A-D. *Pronectria oligospora*. A. Median section of peritheciium. B. Surface cells. C. Ascus and ascospores. D. Conidia and conidiophore. E-H. *Nectria rubefaciens*. E. Ascus and ascospores. F. Setae. G. Top view of setae. H. Conidia and conidiophore. Bar = 100 μm in A, 10 μm in B-H.

Additional specimens examined: FRANCE. Midi-Pyrenes: Tarn (81), LaFontasse, Grottes St. Dominique, on Parmelia borrieri (Sm.) Turner [= Punctelia borrieri (Sm.) Krog] on Quercus pubescens, 700 m, 10 Dec 1992, C. Coste (herb Coste; NY); Provence: Var Pierrefeu-du-Var, 1.5 km from Bcasson, on Parmelia subrudecta Nyl. [= Punctelia subrudecta (Nyl.) Krog] on bark of Quercus pubescens in Quercus ilicis, 80 m, 15 Jun 1991, C. Roux (herb Roux; NY). U.S.A. Connecticut: Hebron, Hemlocks Camp, on Punctelia sp. on bark on ground, 31 Aug 1992, R. Lowen 929-92 (NY); Hartford County, Salmon River State Forest, on Punctelia sp. on stick on ground, 16 Sep 1990, R. Lowen 778 (NY); Litchfield County, Litchfield, White Memorial Foundation, on Punctelia sp. on bark on ground, 15 Oct 1992, R. Lowen 1030-92 (NY). Georgia: Towns/Rabun Counties, Chattahoochee Natl. Forest, along Appalachian Trail betw Dicks Creek Gap and Little Bald Knob at US 76, ca. 34 54'N, 83 37'W. 825-900 m; mesic hardwood forest, on Punctelia rudecta, 21 Sep 1992, W.R. Buck 21679 (NY). Missouri: Ste. Genevieve County, Pickle Springs Natural Area, oak woods and sandstone glade, on Punctelia rudecta, 26 Sep 1990, R.C. Harris 25977A (NY). New Jersey: Hunterdon County, Delaware Township, Mitchell property, between Upper Creek & Pine Hill Rds., ca 40 25', 74 56'W, triassic mudstones & shale, juniper and hardwoods along stream between house & road, on P. rudecta on Fraxinus, 4 Nov 1992, R.C. Harris 29016 (NY); same location, hemlock & hardwoods along Wickecheoke Creek, on P. rudecta on Acer rubrum, 4 Nov 1992, R.C. Harris 29046 (NY); same location, on P. rudecta on Platanus, 4 Nov 1992, R.C. Harris 29048 (NY); same location, on P. rudecta on Fraxinus americana, 4 Nov 1992, R.C. Harris 29047 (NY); same location and adjacent areas, ca. 100 m, Juniperus & mixed hardwoods on moist soil, on P. rudecta, 4 Nov 1992, R.C. Harris 22258 [R. Lowen 1059-92] (NY); same location and habitat, on P. rudecta, 4 Nov 1992, R.C. Harris 22259 [R. Lowen 1060-92] (NY); same location habitat and host, 4 Nov 1992, R.C. Harris 22260 [R. Lowen 1061-92] (NY). New York: Warren County, Warrensburg, Pack Forest, on dying Punctelia, 12 Sep 1992, S. VanHook [R. Lowen 979-92] (NY); Wyoming County, Letchworth State Park, on Punctelia on stick, 19-20 Sep 1992, R. Lowen 1027 (NY).

Discussion: The two collections of Pronectria oligospora from France differ from the U.S.A. material in having eight ascospores per ascus. Also the ascospores are slightly roughened. In the U.S.A. collections the ascospores number 2-5 per ascus and are smooth.

Several collections made by R. Santesson from Sweden of P. oligospora have ascospores that become inflated and eventually disarticulate at the septum. These collections are tentatively accepted as P. oligospora.

Within the genus Pronectria, Pronectria anisospora and P. oligospora have additional characters in common. They have subglobose ascomata whereas other members of the genus have pyriform ascomata. The elongate, unequally-celled ascospores might be considered allantoid and the sizes overlap. The ascospores of P. oligospora tend to be larger and one cell of the ascospores of P. anisospora is often subglobose. Both species are found on members of the Parmeliaceae and

both degrade the thallus of the host lichen. The anamorphs of both are species of Acremonium with elongate conidia.

Pronectria oligospora may be distinguished from P. anisospora in several ways. The lichen hosts differ. Pronectria anisospora is found on Hypogymnia physodes; P. oligospora occurs on Punctelia. The ascomata of the two species differ in color. Those of Pronectria anisospora are bright orange while they are red in P. oligospora. The occasional color change of ascomata of P. oligospora in lactic acid and the recurved setae on ascomata of P. anisospora are other differences. The Acremonium anamorphs are distinguished by the more prominent basal abscission scar and the generally larger conidia in P. anisospora. This anamorph is distinguished from other species of Acremonium by having septate conidiophores and subcylindrical conidia that average greater than 12 μm long.

Pronectria oligospora is distinguished from other species of Pronectria by the red, subglobose ascomata and the smooth, narrowly ellipsoid ascospores.

NECTRIA RUBEFACIENS

Nectria rubefaciens Ellis & Everhart, Journ. Mycol. 3: 116. Oct 1887. FIGS. E-G.

LECTOTYPE [designated here]: U.S.A. New Jersey: Newfield, on sterile thallus of lichen on dead fallen maple limb, 25 Sep 1887, J.B. Ellis; SYNTYPE: on thallus of some foliaceous lichen, Oct 1887, J.B. Ellis (both NY!) [both on Rimelia cetrata (Ach.) Hale & Fletcher].

ANAMORPH: Acremonium rhabdosporum W. Gams.

HABITAT: Parmelia, Flavoparmelia, Punctelia.

KNOWN DISTRIBUTION: Luxembourg (P. Diederich, pers. comm.), U.S.A. (east coastal states: N. Carolina to Rhode Island).

Ascomata subglobose, 80-160 μm diam, superficial, scattered or in groups of up to 10, each on a small stromatic base, red-orange, not changing color in KOH or lactic acid, sometimes collapsing by lateral pinching when dry. Setae scattered around ostiole, clavate, (11-)14-24 μm long x (3.5-)5.5-6.5(-10) μm at widest tapering to 2-3 μm at base; apex rounded, 0-1 septate, hyaline; walls thick except at pore at apex; lumina becoming teardrop-shaped; arising singly. Cells on surface of ascomata where not obscured by setae epidermoid consisting of puzzle-like cells connected by fine pores. Ascomatal wall simple, 10-12 μm wide. Asci clavate, 22-45(-57) x 8-10(-12) μm , unitunicate, apex rounded to truncate, apical ring absent; ascospores biseriate, adhering together after ejection. Ascospores subcylindrical, (12-)14-18(-20) x 2.5-3.0(-4) μm , L/W 5.8; 1-septate, hyaline, becoming pale brown, smooth,

curved, several guttules per cell, usually 8 per ascus. Lichen thallus often reddening in presence of ascomata.

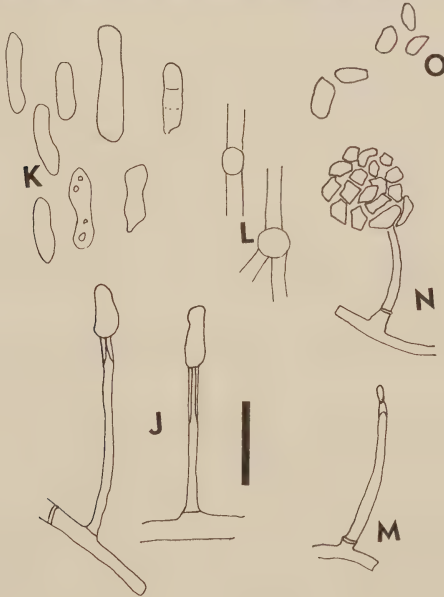
CHARACTERISTICS IN CULTURE. Ascospores germinating overnight from terminal ends of both cells. Colonies grown 7 da, 20°C light, 10°C dark. CMD: 7-10 mm diam, opaque. Colonies reaching a maximum of 2 cm in 3 months; aerial mycelium scant, of erect, parallel conidiophores; center raised, pale orange, becoming brownish orange; distal area white; zonate; margin feathery; reverse slightly darker. Conidial production visible after 3 da. Conidiophores semimacronematous, 14-21(-49) μm long x 1 μm , tapering to 0.5-1.0 μm at tip, perpendicular to subtending hypha, unbranched, hyaline, smooth, 1- or 2-septate, terminating in a single conidiogenous cell; basal septum 1.5 μm from subtending hypha; tip of phialides with visible periclinal thickening, not flared. Conidia elongate-cylindrical, (8-)15-20(-22) x 2.5-3.0(-3.5) μm , L/W 6.3; with or without a slightly protuberant, basal abscission scar, unicellular, straight, smooth, hyaline; wall thickened at both ends, aggregating in hyaline droplet of liquid at tip of phialide, conidia lined up in parallel rows; droplets becoming confluent, pale orange. Chlamydospores absent.

Additional specimens examined: LUXEMBOURG. Gutland: between Hollenfels and Tuntange (L8.44.11), in a *Salix-Fraxinus* wood, 21 Nov 1987, P. Diederich & G. Marson (Herb. Diederich, NY). U.S.A. Connecticut: Hebron, Hemlocks Camp, near lake, on *Parmelia sulcata* Taylor on ground, 2 Sep 1992, R. Lowen 925 (with *Acremonium*, NY); Hartford County, Salmon River State Park, near entrance, on *Parmelia sulcata* on bark of fallen tree, 18 Sep 1988, R. Lowen 628 [G.J. Samuels 88-66] (IMI, NY); Litchfield County, White Memorial Foundation, Catlin Woods, on *Punctelia* sp., 15 Oct 1992, R. Lowen 1032 (NY); Tolland County, Gay City State Park, on *Punctelia* sp. on wood on ground, 16 Sep 1989, R. Lowen 751, (as *Acremonium rhabdosporum*, NY); Windham County, Natchaug State Park, near river, on damaged thallus of *Flavoparmelia caperata* (L.) Hale, 17 Sep 1988, R. Lowen 625 (NY). Georgia: Chattahoochie Nat. Forest, 26 Sep 1992, G.J. Samuels [R.Lowen 1064-92] (NY). Maryland: Garrett County, 5 mi W of Barton Little Savage River Ravine, 23 Sep 1989, G.J. Samuels, C.T. Rogerson, W.R. Buck & R.C. Harris (NY); high bog, 5.5 mi SSW of Univ. Maryland 4-H camp, ca. 12 mi S of Grantsville, 854 m, hardwoods, 24 Sep 1989, W.R. Buck & R.C. Harris (NY). New Jersey: Ocean County, Lakehurst, Hurricane Branch of Tom's River, on discolored part of thallus of *Parmelia sulcata*, on fallen branch of pitch pine, 14 Oct 1989, C.T. Rogerson (NY). New York: Dutchess County, Pawling Nature Reserve, on *Flavoparmelia caperata* on branch on ground, 6 Oct 1990, R. Lowen 853 (with *Acremonium*, NY); St. Lawrence County, Wanakena, SUNY Ranger School, road to bog, on *Parmelia sulcata* on stick on ground, 27 Aug 1988, R. Lowen 601 [G.J. Samuels 88-71] (NY); same location, reservoir road, on *Parmelia sulcata* on bark on ground, 27 Aug 1988, R. Lowen 587 (NY); Ulster County, Frost Valley YMCA Camp, E end of Low Wildcat Trail across river from camp, hardwoods; 610 m, on *Parmelia squarrosa* Hale, on *Acer rubrum*, 9 Sep 1989, R.C. Harris 24490A (NY); Warren County, Warrensburg, Pack Forest, on discolored *Parmelia* sp. on ground, 12 Sep 1992, R. Lowen 951 (with

Acremonium, NY). North Carolina: on Punctelia subrudecta, on Quercus, R.C. Harris 24583A (NY); Macon County, Nantahala Natl. Forest, W of Franklin, Wine Spring Bald, W of Wayah Bald, 26 Sep 1989, G.J. Samuels, C.T. Rogerson, W.R. Buck, & R.C. Harris, (NY). Rhode Island: Washington County, Pine Hill Rd., Carolina Management area, on Flavoparmelia caperata, 5 Aug 1988, R. Lowen 611-88 (IMI, NY). Virginia: Grayson County, Grayson Highlands State Park, Wilburn Ridge, ca. 36 38'N, 81 31'W, 1430-1540 m. along Appalachian Trail, on Punctelia subrudecta, 12 Sep 1992, W.R. Buck 20678 [R. Lowen 1048-92] (NY).

Discussion: Ellis & Everhart (1887), in the protologue stated that Nectria rubefaciens was "parasitic on thallus of some lichen on various dead limbs lying on the ground". The lectotype was chosen from the best of available material collected by Ellis in Newfield, NJ.

Nectria rubefaciens has ascospores and conidia similar to those of Pronectria oligospora but may be distinguished by its superficial ascomata with distinctive, clavate setae. The size of the conidia of Acremonium rhabdosporum overlaps with that of the Acremonium anamorph of P. oligospora but may be distinguished by having walls that are thickened at both ends.



J-L. Acremonium sp. I. J. Conidiophores. K. Conidia. L. Chlamydospores. M-O. Acremonium sp. II. M. Conidiophore with developing conidium. N. Conidiophore with aggregated conidia. O. Conidia. Bar = 10 μ m.

ACKNOWLEDGMENTS

Acknowledgments are given to the New York Botanical Garden for giving me space to work, C.T. Rogerson for his generous help and advice, G.J. Samuels for his culture of Nectria rubefaciens, G. Katsban for his drawing of Pronectria oligospora, W.R. Buck and R.C. Harris for their many collections of lichenicolous fungi, R.C. Harris for help with lichen identifications, especially the identification of the host lichen of Nectria rubefaciens, and Rupert Barneby for his help with the Latin. I thank G.J. Samuels for being my presubmission reviewer.

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MYCOTAXON

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INDEX OF LICHENES GROENLANDICI EXSICCATI: FASCICLE I-X

With notes on distribution of the taxa in Greenland

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ABSTRACT

This list of lichens, which have been issued in "Lichenes Groenlandici Exsiccati" from 1972 to 1994, includes 200 accepted taxa. Notes are presented on the known distribution of these taxa in Greenland together with a number of synonyms.

Since 1972 the Botanical Museum, University of Copenhagen (C) has distributed ten fascicles of Greenland lichen specimens in the series, "Lichenes Groenlandici Exsiccati". The exsiccata, which from the beginning has been edited by the author of this paper, is now distributed in 31 complete sets. The recipients include ALA, AMNH, ASU, B, BM, BP, C, CANL, CL, DUKE, FH, G, GB, GZU, H, KUO, LE, LD, M, MICH, O, PC, QK, S, TNS, U, UPS, US, W, WA and WIS.

I intend to collect additional exsiccata material in the summer of 1994. Together with remaining collections from 1992 and 1993 there will be sufficient material for fascicle XI (totally 50 numbers). Other contributions to the exsiccata would be welcome.

In the following an alphabetical list is given of the lichens issued in fascicle I-X, together with some synonyms (I: No.1-50, II: 51-110, III: 111-160, IV: 161-210, V: 211-260, VI: 261-310, VII: 311-360, VIII: 361-416, IX: 417-466, X: 467-500. Notes are also given of the known distribution of the 200 lichens in Greenland (the whole Greenland lichen flora consists of c. 1100 species).

Alectoria nigricans (Ach.) Nyl. - All over Greenland
151,196,323,405,431
A. ochroleuca (Hoffm.) Massal. - All over Greenland, but rare
in N. Greenland 18,87,256,265,298,358,408,422
A. sarmentosa (Ach.) Ach. subsp. *vexillifera* (Nyl.) D. Hawksw.
(Syn. *A. vexillifera* (Nyl.) Stizenb.) - W. Greenland, northwards
to Disko-Nuussuaq; rare in E. Greenland 377,498

Allantoparmelia alpicola (Th. Fr.) Essl. (Syn. *Parmelia alpicola* Th. Fr.) - W. Greenland, northwards to Qaanaaq; E. Greenland, northwards to Traill Island 141,312

Amygdalaria panaeola (Ach.) Hertel & Brodo - W. Greenland; Central E. Greenland 168

Arctocetraria andrejevii (Oxner) Kärnef. & Thell (Syn. *Cetraria andrejevii* Oxner) (Krog 1968; Kärnefelt 1979; Kärnefelt, Mattsson & Thell 1993; Santesson 1993) - W. Greenland, with northern limit at Upernavik; very rare in E. Greenland (Lindenows Fjord and Mesters Vig) 31,142,383,397,403,425,435,473
A. nigricascens (Nyl.) Kärnef. & Thell (Syn. *Cetraria nigricascens* (Nyl.) Elenkin) (Hansen 1981) - N. and N.W. Greenland, southwards to Uummannaq; rare in E. Greenland (Ittoqqortoormiit) 302,356,361,464,495

Arctoparmelia centrifuga (L.) Hale (Syn. *Parmelia centrifuga* (L.) Ach.) - W. Greenland, but rare north of Disko; scattered distribution in E. Greenland northwards to Kong Oscars Fjord 41,375,445,471

A. incurva (Pers.) Hale (Syn. *Parmelia incurva* (Pers.) Fr.) - W. Greenland, with northern limit at Qaanaaq 178

Arctopeltis thuleana Poelt - The whole of W. Greenland. 478

Arthrorhaphis citrinella (Ach.) Poelt - All over Greenland 342

Baeomyces placophyllus Ach. - W. Greenland, with northern limit at Qaanaaq; a few localities between 72°N and 75°N in E. Greenland 246

B. rufus (Huds.) Rebent. - W. Greenland, northwards to Upernavik; rare in E. Greenland (Ittoqqortoormiit, Frans Josefs Fjord) 245

Bellemerea alpina (Sommerf.) Clauz. & Roux (Syn. *Aspicilia alpina* (Sommerf.) Arnold) - W. Greenland, northwards to Disko-Nuussuaq; E. Greenland, northwards to Ittoqqortoormiit 324

Biatora vernalis (L.) Fr. (Syn. *Lecidea vernalis* (L.) Ach.) - All over Greenland 212

Brodoa oroarctica (Krog) Goward (Syn. *Hypogymnia oroarctica* Krog) - All over Greenland 192

Bryocaulon divergens (Ach.) Kärnef. (Syn. *Cornicularia divergens* Ach.) - All over Greenland, but rare in E. Greenland (Ittoqqortoormiit) 125,136,140,156,209,272,328

Bryoria chalybeiformis (L.) Brodo & D. Hawksw. (Syn. *Alectoria chalybeiformis* (L.) Gray) - All over Greenland, but most frequent in W. Greenland) 51,118,133,307,326,415,450

B. nitidula (Th. Fr.) Brodo & D. Hawksw. (Syn. *Alectoria nitidula* (Th. Fr.) Vainio) - W. Greenland, northwards to Qaanaaq 20,126,194,299,357,360,367,486

Buellia insignis (Naeg. ex Hepp) Th. Fr. - W. Greenland, northwards to Nuussuaq; rare in E. Greenland (?) 492

Caloplaca alcarum Poelt (Hansen, Poelt & Søchting 1987) (Distributed as "10. *Caloplaca marina* Wedd.") - All over Greenland, northwards to Qaanaaq in W. Greenland and Jørgen Brønlund Fjord in E. Greenland 10

C. fraudans (Th. Fr.) H. Olivier (Hansen, Poelt & Søchting 1987) - W. Greenland, northwards to Upernavik; E. Greenland, northwards to Kong Oscars Fjord 251

C. jungermanniae (Vahl) Th. Fr. - All over Greenland, but usually rather sparse on its habitats 454

C. tominii Savicz - Rare in both W. Greenland (Søndre Strømfjord, Disko-Nuussuaq) and E. Greenland (Jørgen Brønlund Fjord) 338,455

Candelariella arctica (Körber) R. Sant. (Syn. *C. crenulata* (Wahlenb.) Zahlbr.) - W. Greenland, northwards to Disko-Nuussuaq 248

C. placodizans (Nyl.) Magnusson - All over Greenland 6,161,268,309,344,427,483

Catapyrenium lachneum (Ach.) R. Sant. (Syn. *Dermatocarpon rufescens* (Ach.) Th. Fr.) (Breuss & Hansen 1988) - All over Greenland 108

Cephalophysia leucospila (Anzi) Kiliass & Scheideg. (Syn. *Lecidea ultima* Th. Fr.) - Between 73°N and 75°N in E. Greenland 420

Cetraria commixta (Nyl.) Th. Fr. - W. Greenland, northwards to Disko; S.E. Greenland; very rare in N.E. Greenland . 497

C. cucullata (Bellardi) Ach. - All over Greenland 16,297,317,469

C. hepatizon (Ach.) Vainio - All over Greenland, but very rare in the northernmost areas 193,350

C. islandica (L.) Ach. - All over Greenland . 36,53,316,359

C. muricata (Ach.) Eckfeldt (Syn. *Coelocaulon muricatum* (Ach.) Laundon) - All over Greenland 67

C. nigricans Nyl. - W. Greenland, with northern limit at Qaanaaq 5,91,113,255,277,395,490

C. nivalis (L.) Ach. - All over Greenland; extremely widespread and common 15,57,159,303,318,424,468

C. sepincola (Ehrh.) Ach. (Hansen 1978a) - S.W. and S.E. Greenland; northern limit at c.66°N 17,271

Cetrariella delisei (Bory ex Schaerer) Kärnef. & Thell (Syn. *Cetraria delisei* (Bory ex Schaerer) Nyl.) (Kärnefelt, Mattsson & Thell 1993) - All over Greenland 34,55,158,197,301,319,368,378,434,449

Chaenotheca furfuracea (L.) Tibell (Syn. *Coniocybe furfuracea* (L.) Ach.) - All over Greenland except the northernmost areas 242

Cladina arbuscula (Wallr.) Hale & Culb. (Syn. *Cladonia arbuscula* (Wallr.) Flotow) (Thomson 1984) - S.W. Greenland . . 32,210

- C. mitis* (Sandst.) Hustich (Syn. *Cladonia mitis* Sandst.) - All over Greenland apart from N. and N.E. Greenland 27,88,381,437
- C. rangiferina* (L.) Nyl. (Syn. *Cladonia rangiferina* (L.) Wigg.) - W. Greenland, E. Greenland (?) 89
- C. stellaris* (Opiz) Brodo (Syn. *Cladonia alpestris* (L.) Rabenh.) - W. Greenland, northwards to Disko and Ilulissat 35,56,99,135,387,407,430,442,474
- C. stygia* (Fr.) Ahti (Ahti & Hyvönen 1985) (Syn. *Cladonia stygia* (Fr.) Ruoss) - W. Greenland; S.E. Greenland (det. T. Ahti 1994) 29,162,386,428,446

- Cladonia acuminata* (Ach.) Norrlin - W. Greenland, with northern limit at Prøven, Central E. Greenland 138
- C. amaurocraea* (Flörke) Schaerer - All over Greenland apart from N.E. Greenland 54,128,132,406
- C. bellidiflora* (Ach.) Schaerer - W. Greenland, with northern limit at Qaanaq; S.E. Greenland, northwards to Ammassaliklik 25,164,182,376,436,447
- C. borealis* Stenroos - All over Greenland apart from the northernmost areas (det. S. Stenroos) 204
- C. cariosa* (Ach.) Sprengel - All over Greenland apart from the northernmost areas 104,139,262
- C. carneola* (Fr.) Fr. - W. Greenland, northwards to Disko; S.E. Greenland, northwards to Tugtilik 44
- C. cornuta* (L.) Hoffm. - All over Greenland except N. Greenland 393
- C. crispata* (Ach.) Flotow - W. Greenland, northwards to Disko; S.E. Greenland, northwards to Tugtilik 227,233,390
- C. cyanipes* (Sommerf.) Nyl. (Hansen 1978b) - W. Greenland, northwards to Upernavik; E. Greenland, northwards to Kejser Franz Joseph Fjord 111,394
- C. ecmocyna* Leighton - All over Greenland except the northernmost areas 37,114,120,369,423
- C. fimbriata* (L.) Fr. s.lat. - W. Greenland, with northern limit at Qaanaq; E. Greenland, northwards to Traill Island 278
- C. gracilis* (L.) Willd. (Ahti 1980) (No. 216 = subsp. *nigripes* (Nyl.) Ahti) - All over Greenland except its northernmost parts 216
- C. macroceras* (Delise) Ahti - All over Greenland except the northernmost areas 68,231
- C. macrophylla* (Schaerer) Stenh. (Syn. *C. alpicola* (Flotow) Vainio) - W. Greenland, with northern limit at Qaanaq; E. Greenland, northwards to Kong Oscars Fjord 30,179,234
- C. macrophyllodes* Nyl. (No. 409 has been distributed as "*Cladonia cervicornis* (Ach.) Flot.") - W. Greenland, northwards to Disko; E. Greenland, northwards to Kong Oscars Fjord 174,409,441
- C. phyllophora* Hoffm. (Syn. *C. degenerans* (Flörke) Sprengel) - W. Greenland, northwards to Disko-Nuussuaq; S.E. Greenland, northwards to Tugtilik 274
- C. pleurota* (Flörke) Schaerer - All over Greenland except N. and N.E. Greenland 26,72
- C. pocillum* (Ach.) Grognot - All over Greenland, even in Peary Land 199,346
- C. pyxidata* (L.) Hoffm. - All over Greenland 63,458
- C. squamosa* Hoffm. - W. Greenland with northern limit at Qaanaq; E. Greenland, northwards to Kejser Franz Joseph Fjord 65

- C. stricta* (Nyl.) Nyl. (Syn. *C. lepidota* auct.) - All over Greenland except N. and N.E. Greenland north of c.75°N . . . 92,236,273,279,467
- C. sulphurina* (Michaux) Fr. (Syn. *C. gonecha* (Ach.) Asah.) - W. Greenland, northwards to Qaanaaq; E. Greenland, northwards to Ittoqqortoormiit . . . 50,71,84,373
- C. uncialis* (L.) Wigg. - W. Greenland, northwards to Disko-Nuussuaq; E. Greenland, northwards to c.73°N . . . 28,380,451
- Dactylina arctica* (Richardson) Nyl. - All over W. Greenland, but rare towards the south . . . 100,112,122,306,488
- D. ramulosa* (Hook.) Tuck. - N. and N.W. Greenland, southwards to Disko; rare in N.E. Greenland (Danmarkshavn) . . . 94,116,123,289
- Dermatocarpon miniatum* (L.) Mann - W. Greenland, northwards to Disko; E. Greenland, northwards to Kangerlussuaq . . . 259
- D. rivulorum* (Arnold) Dalla Torre & Sarnth. - W. Greenland, northwards to Disko; E. Greenland, northwards to Ittoqqortoormiit . . . 252
- Dibaes baeomyces* (L.fil.) Rambold & Hertel (Syn. *Baeomyces roseus* Pers.) - All over Greenland . . . 244
- Ephebe lanata* (L.) Vainio - W. Greenland, northwards to Disko; scattered distributed in E. Greenland (Ammassalik, Ittoqqortoormiit, Kong Oscars Fjord) . . . 189,379
- Fulgensia bracteata* (Hoffm.) Räsänen - Central W. Greenland; Central E. and N.E. Greenland . . . 336
- Gyalecta friesii* Flotow ex Körber (Hansen, Poelt & Vezda 1987) - W. Greenland, northwards to Disko . . . 239
- Hypogymnia austerodes* (Nyl.) Räsänen - W. and N. Greenland . . . 11,203,413
- H. physodes* (L.) Nyl. - W. Greenland, northwards to Qaanaaq; very rare in E. Greenland (Ittoqqortoormiit) . . . 7,258
- Icmadophila ericetorum* (L.) Zahlbr. - S.W. and S.E. Greenland . . . 253,461
- Ionaspis odora* (Ach.) Stein (Syn. *I. suaveolens* (Schaerer) Th. Fr.) - Rare in N.W. and N.E. Greenland . . . 465
- Lasallia pensylvanica* (Hoffm.) Llano (Syn. *Umbilicaria pensylvanica* Hoffm.) - S.W. Greenland, northwards to Sisimiut . . . 232,281
- Lecanora circumborealis* Brodo & Vitik. (Syn. *L. coilocarpa* auct.) - S.W. Greenland . . . 276
- L. epibryon* (Ach.) Ach. - All over Greenland . . . 217,332,462
- L. geophila* (Th. Fr.) Poelt (Syn. *L. pachythallina* Lynge) (Poelt 1986) - W. Greenland northwards to Qaanaaq; between 72°N and 74°N i E. Greenland . . . 345
- L. leptacina* Sommerf. - W. Greenland, northwards to Disko; very rare in E. Greenland (Mikis Fjord, Ittoqqortoormiit) . . . 186

- L. marginata* (Schaerer) Hertel & Rambold (Syn. *Lecidea marginata* Schaerer, *Lecidea elata* Schaerer) (Alstrup 1986) - W. Greenland, northwards to Qaanaaq; E. Greenland, northwards to Jørgen Brønlund Fjord; no reports of the species from S.E. Greenland) . 339
- L. muralis* (Schreber) Rabenh. - S.W. and W. Greenland, northwards to Disko 22
- L. polytropa* (Hoffm.) Rabenh. - All over Greenland 42,190,269
- L. rupicola* (L.) Zahlbr. ssp. *arctoa* Leuckert & Poelt - Central W. Greenland (Disko) 167
- L. straminea* Wahlenb. ex Ach. - W. Greenland northwards to Nuussuaq; S.E. Greenland 1,60,250
- L. swartzii* (Ach.) Ach. (Syn. *L. subradiosa* Nyl.) - S.W. Greenland, northwards to Disko 145
- Lempholemma polyanthes* (Bernh. in Schrad.) Malme (Syn. *L. myriococcum* (Ach.) Th. Fr.) - W. Greenland, northwards to Disko 176
- Lepraria neglecta* (Nyl.) Erichsen (Syn. *Crocynia neglecta* (Nyl.) Hue) - All over Greenland 83,320
- Leprocaulon subalbicans* (Lamb) Lamb & Ward - W. Greenland, with northern limit in the Thule district; rare in E. Greenland (Ammassalik, Ittoqqortoormiit) 219,411
- Leproloma vouauxii* (Hue) Laundon (Syn. *Lepraria arctica* (Lynge) Wetm.) - All over Greenland except N.W. Greenland . . . 348
- Leptochidium albociliatum* (Desmaz.) M. Choisy (Syn. *Polychidium albociliatum* (Desmaz.) Zahlbr.) - Central W. Greenland (Disko) 175
- Leptogium saturninum* (Dickson) Nyl. - W. Greenland, northwards to Maarmorilik 115,214
- Lobaria scrobiculata* (Scop.) DC. in Lam. & DC. - S.W. Greenland, northwards to Qasigiannnguit 137,224
- Massalongia carnosa* (Dickson) Körber - W. Greenland, with northern limit at Upernavik; rare in E. Greenland (Ammassalik, Ittoqqortoormiit) 220,487
- Melanelia infumata* (Nyl.) Essl. (Syn. *Parmelia infumata* Nyl.) - All over Greenland, even the high arctic areas . 77,177
- M. septentrionalis* (Lynge) Essl. (Syn. *Parmelia septentrionalis* (Lynge) Ahti) - W. Greenland, northwards to Qaumarujuk at Maarmorilik 180,275
- Micarea assimilata* (Nyl.) Coppins (Syn. *Lecidea assimilata* Nyl.) - All over Greenland 172,247,401
- Miriquidica atrofulva* (Sommerf.) Schwab & Rambold (Syn. *Lecidea atrofulva* Sommerf.) - W. Greenland, northwards to Upernavik; more rare or neglected in E. Greenland (Ammassalik) . . 426
- M. leucophaea* (Flörke ex Rabenh.) Hertel & Rambold (Syn. *Lecidea leucophaea* (Flörke ex Rabenh.) Nyl.) - W. Greenland, northwards

to Disko; S.E. Greenland, northwards to Mikis Fjord; Central E. Greenland(?) 185

Nephroma arcticum (L.) Torss. - W. Greenland, northwards to Disko; rare in S.E. Greenland (Qaartuluk, Ammassalik) 33,86,181,183,370,388,472

N. expallidum (Nyl.) Nyl. - W. Greenland, northwards to Prøven (c.72°N); rare in E. Greenland (Kong Oscars Fjord) 98,282,416,489

N. parile (Ach.) Ach. - W. Greenland, northwards to Svartenhuk Peninsula; S.E. Greenland, northwards to Tugtilik 109,235,280

Ochrolechia frigida (Swartz) Lynge (including *O. lapuënsis* (Vain. in Räsänen) Räsänen) - All over Greenland 24,412

O. grimmiae Lynge - W. Greenland, northwards to Upernavik; rare in E. Greenland (Ammassalik, Tugtilik) 46,163

O. tartarea (L.) Massal. - S.W. Greenland; rare in S.E. Greenland 500

Omphalina hudsoniana (Jennings) H. Bigelow (Syn. *Coriscium viride* (Ach.) Vainio) - W. Greenland, northwards to Qaanaaq; rare in E. Greenland (Isertoq near Ammassalik) 452,485

Orphniospora moriopsis (Massal.) D. Hawksw. (Syn. *Buellia atrata* (Sm.) Anzi) - All over Greenland 146,372,460

Parmelia fraudans (Nyl.) Nyl. - W. Greenland, northwards to Disko 121

P. saxatilis (L.) Ach. - All over Greenland, but rare in N. and N.E. Greenland 19,195,385,484

P. sulcata Taylor - All over Greenland except N. and N.E. Greenland 12

Parmeliella arctophila (Th. Fr.) Malme - Disko 153

Parmeliopsis ambigua (Wulfen in Jacq.) Nyl. (E.S. Hansen 1978b) - S.W. Greenland, northwards to Qasigiannuit; rare in E. Greenland (Ammassalik, the inner part of Scoresby Sund) 223,396

P. hyperopta (Ach.) Arnold - S.W. Greenland; rare in S.E. Greenland (Skjoldungen) 257

Peltigera aphthosa (L.) Willd. - All over Greenland, but rare to the north (the Greenland material of *Peltigera* is at present under revision) 13,81,392,429

P. canina (L.) Willd. - All over Greenland except N. and N.E. Greenland (det. O. Vitikainen) 62,73

P. collina (Ach.) Schrader (Syn. *P. scutata* (Dickson) Duby) - W. Greenland, northwards to Disko 493

P. didactyla (Witt.) Laundon (Syn. *P. spuria* (Ach.) DC.) - All over Greenland 74,399

P. leucophlebia (Nyl.) Gyelnik; . - All over Greenland, but rare to the north 198,453,470

P. malacea (Ach.) Funck - All over Greenland except N. and N.E. Greenland north of 75°N 52

- P. rufescens* (Weis) Humb. - All over Greenland. The species is the only *Peltigera* occurring in the extreme high arctic part of Greenland 335
- P. scabrosa* Th. Fr. - W. Greenland, northwards to Siorapaluk; S.E. Greenland 391,475
- P. venosa* (L.) Hoffm. - All over Greenland except N. and N.E. Greenland 206,418
- Pertusaria coriacea* (Th. Fr.) Th. Fr. - All over Greenland 201
- P. dactylina* (Ach.) Nyl. - All over Greenland except the northernmost areas 205,457
- P. oculata* (Dickson) Th. Fr. - W. Greenland, with northern limit af Qaanaaq; E. Greenland, northwards to Kong Oscars Fjord 261,398,448,476
- Phaeocalicium compressulum* (Nyl. ex Szat.) A. Schmidt - S.W. Greenland, northwards to c. 66°N. 222
- Physcia caesia* (Hoffm.) Fűrnr. (Moberg & Hansen 1986) - All over Greenland, even the extreme high arctic areas . . 243
- Physconia detera* (Nyl.) Poelt - W. Greenland, northwards to Disko-Nuussuaq 144
- P. muscigena* (Ach.) Poelt (Moberg & Hansen 1986) - All over Greenland, even the high arctic areas . 78,211,331,340,477
- Pilophorus dovrensis* (Nyl.) Timdal, Hertel & Rambold (Syn. *Lecidea pallida* Th. Fr.) - W. Greenland, northwards to Disko; E. Greenland, northwards to Kong Oscars Fjord 169,249
- Placopsis gelida* (L.) Lindsay - W. Greenland, northwards to Disko; E. Greenland, northwards to Kong Oscars Fjord . 207
- Platismatia glauca* (L.) Culb. & C. Culb. - S.W. Greenland, northwards to Nuuk 254,496
- Porpidia macrocarpa* (DC. in Lam. & DC.) Hertel & Schwab (Syn. *Huilia macrocarpa* (DC. in Lam. & DC.) Hertel; *Lecidea macrocarpa* (DC. in Lam. & DC.) Steudel) - Central W. Greenland (Disko) 165
- P. melinodes* (Körber) Gowan & Ahti (Gowan & Ahti 1993) - W. Greenland, with northern limit at Qaanaaq; rare (?) in E. Greenland (Ittoqqortoormiit, Jørgen Brønlund Fjord) . . . 291,351,371
- Problastenia rupestris* (Scop.) Steiner - All over Greenland except N.W. Greenland 352
- Pseudephebe minuscula* (Nyl. ex Arnold) Brodo & D. Hawksw. (Syn. *Alectoria minuscula* (Nyl. ex Arnold) Degel.) - All over Greenland 296,321,365,432
- P. pubescens* (L.) M. Choisy (Syn. *Alectoria pubescens* (L.) R. Howe) - All over Greenland, but rare in N. Greenland 40,148,215,404
- Psora rubiformis* (Ach.) Hook. (Syn. *Lecidea rubiformis* (Ach.) Wahlenb.) - All over Greenland 79,107,147,310,343

P. vallesiaca (Schaerer) Timdal (Syn. *P. albilabra* (Duf.) Körber)
- S.W. and N. Greenland (Kangerlussuaq; Peary Land) . . . 337

Psoroma hypnorum (Vahl) Gray - All over Greenland except the
northernmost regions 23,226

Psorula rufonigra (Tuck) G. Schneider (Syn. *Lecidea rufonigra*
(Tuck.) Nyl.) - S.W. Greenland (Narssarsuaq; Kangerlussuaq)
. 456

Rhizocarpon atroflavescens Lynge - N.E. Greenland (Jørgen Brønlund
Fjord) 334

R. bolanderi (Tuck.) Herre - W. Greenland, northwards to Uperna-
vik 124

R. geminatum Körber (Syn. *R. disporum* auct. non (Naeg. ex Hepp)
Müll. Arg.) - All over Greenland 238,419

R. geographicum (L.) DC. - All over Greenland
. 58,184,191,327,362

R. grande (Flörke ex Flotow) Arnold - All over Greenland except
N. Greenland 61

R. inarense (Vainio) Vainio - W. Greenland, northwards to Uperna-
vik; more rare in E. Greenland (the fjords around Ammassalik;
Ittoqqortoormiit) 438

R. pusillum Runem. - Central and northernmost parts of Green-
land 295, (333)

R. superficiale (Schaerer) Vainio subsp. *boreale* Runem. (Syn.
R. crystalligenum Lynge) - All over Greenland 3,382

Rhizoplaca chrysoleuca (Sm.) Zopf (Syn. *Lecanora rubina* (Vill.)
Ach.) - W. Greenland, northwards to Maarmorilik . . . 80,130

R. melanophthalma (DC. in Lam. & DC.) Leuck. & Poelt (Syn. *Lecanora*
melanophthalma (DC. in Lam. & DC.) Ramond) - All over Green-
land 76,363,491

Solorina bispora Nyl. - All over Greenland 202,417

S. crocea (L.) Ach. - All over Greenland except N. and N.E.
Greenland north of 75°N 39,85,322,439

S. octospora (Arnold) Arnold - W. Greenland, northwards to Disko;
between 71°N and 75°N in E. Greenland 97

S. saccata (L.) Ach. - All over Greenland except S.E. and N.W.
Greenland 479

Sphaerophorus fragilis (L.) Pers. - W. Greenland, northwards
to Thule; E. Greenland, northwards to Kuhn Island
. 45,59,263,313,364,384

S. globosus (Huds.) Vainio - W. Greenland, northwards to Thule;
E. Greenland, northwards to Kuhn Island 38,64,166,293

Sporastatia polyspora (Nyl.) Grumm. (Syn. *S. cinerea* (Schaerer)
Körber) - W. Greenland, northwards to Upernavik; E. Greenland,
northwards to Kong Oscars Fjord 157,480

S. testudinea (Ach.) Massal. - All over Greenland
. 149,294,333,347

Stereocaulon alpinum Laurer ex Funck - All over Greenland, but
rare in N. and N.E. Greenland north of 75°N
. 8,170,187,349,421

- S. arcticum* Lynge (Distributed as "49. *Stereocaulon vesuvianum* Pers.") (Lamb 1977) - W. Greenland, northwards to Disko . . . 49,292,355
- S. arenarium* (Savicz) Lamb. - W. Greenland, rare in E. Greenland (Ammassalik, Ittoqqortoormiit) . . . 213,400
- S. botryosum* Ach. - All over Greenland, common in W. Greenland, but more sparsely distributed in E. Greenland . . . 208,440
- S. condensatum* Hoffm. - W. Greenland, northwards to Qaanaaq . . . 173,481
- S. glareosum* (Savicz) Magnusson - W. Greenland, northwards to Qaanaaq; Central E. Greenland (Ittoqqortoormiit, Kong Oscars Fjord) . . . 129,154,241
- S. paschale* (L.) Hoffm. - W. Greenland, northwards to Disko; E. Greenland, northwards to Kong Oscars Fjord . . . 69,228,237,389,443
- S. rivulorum* Magnusson - All over Greenland. . . 341,499
- S. tomentosum* Fr. - W. Greenland, northwards to Disko . 218
- S. vesuvianum* Pers. - All over Greenland except N. and N.E. Greenland . . . 70,134
- Tephromela aglaea* (Sommerf.) Hertel & Rambold (Syn. *Lecidea aglaea* Sommerf.) - W. Greenland, northern limit at Upernavik; rare in E. Greenland (Ittoqqortoormiit) . . . 2
- T. armeniaca* (DC.) Hertel & Rambold (Syn. *Lecidea armeniaca* (DC.) Fr.) W. Greenland, northwards to Qaanaaq; E. Greenland (rare) . . . 150
- Thamnomelia vermicularis* (Swartz) Ach. ex Schaerer (including *T. subuliformis* (Ehrh.) Culb.) - All over Greenland . . 101
- Toninia cumulata* (Sommerf.) Th. Fr. - All over Greenland . . . 482
- T. sedifolia* (Scop.) Timdal (Syn. *T. caeruleonigricans* (Lightf.) Th. Fr.) (Timdal 1991) - All over Greenland, but rare in S.E. Greenland . . . 110,260,329
- Trapeliopsis granulosa* (Hoffm.) Lumbsch. (Syn. *Lecidea granulosa* (Hoffm.) Ach.) - W. Greenland, northwards to Qaanaaq; rare in S.E. Greenland . . . 225
- Tremolecia atrata* (Ach.) Hertel (Syn. *Lecidea dicksonii* auct.) - All over Greenland . . . 43,290,311
- Umbilicaria arctica* (Ach.) Nyl. - All over Greenland, but rare in the extreme high arctic areas . . . 47,131,200,374
- U. cinereorufescens* (Schaerer) Frey - S.W. Greenland, northwards to Disko . . . 127
- U. cylindrica* (L.) Delise ex Duby (Some collections, for example, No. 105 and 285, come very close to *Umbilicaria virginis* Schaerer) - All over Greenland . . . 66,82,105,285,433
- U. decussata* (Vill.) Zahlbr. (Syn. *Omphalodiscus decussatus* (Vill.) Schol.) - All over Greenland . . . 103,354
- U. deusta* (L.) Baumg. - W. Greenland, northwards to Qaanaaq; E. Greenland, northwards to Kong Oscars Fjord . . . 106,119
- U. havaasii* Llano - W. Greenland, northwards to Disko-Nuusuaq . . . 4,270,414

<i>U. hyperborea</i> (Ach.) Hoffm. - All over Greenland apart from N. and N.E. Greenland north of 75°N	95
<i>U. lyngei</i> Schol. (Syn. <i>Agyrophora lyngei</i> (Schol.) Llano - All over Greenland	9,96,143,264,304
<i>U. proboscidea</i> (L.) Schrader - (Hansen 1983) - All over Greenland	90,266,283,288,300,314
<i>U. rigida</i> (Du Rietz) Frey (Syn. <i>Agyrophora rigida</i> (Du Rietz) Llano) - W. Greenland, northwards to Qaanaaq; Lindenows Fjord and Skjoldungen in S.E. Greenland	402
<i>U. torrefacta</i> (Lightf.) Schrader - All over Greenland except N. Greenland	160,240,267,410,444
<i>U. vellea</i> (L.) Ach. - All over Greenland except N. and N.E. Greenland	14,229,353,494
<i>U. virginis</i> Schaerer (Syn. <i>Omphalodiscus virginis</i> (Schaerer) Schol.) - All over Greenland	188,286,308,315

<i>Usnea sphacelata</i> R. Br. (Syn. <i>Neuropogon sulphureus</i> (Koenig) Hellbom) - All over Greenland, at higher elevations in S. Greenland. Max. altitude c. 1700 m a.s.l.	102,152,284,287,325,466
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<i>Varicellaria rhodocarpa</i> (Körber) Th. Fr. - S.W. Greenland, northwards to c.66°N	221
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<i>Verrucaria mucosa</i> Wahlenb. in Ach. - Central W. Greenland (Disko)	117
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<i>Vulpicida pinastri</i> (Scop.) J.-E. Mattsson & M.-J. Lai (Syn. <i>Cetraria pinastri</i> (Scop.) Gray) (Hansen 1978a, Mattsson 1993) - S.W. Greenland, northwards to c. 66°N	230
<i>V. tilesii</i> (Ach.) J.-E. Mattson & M.-J. Lai (Syn. <i>Cetraria tilesii</i> Ach.) - N., N.W. and N.E. Greenland	463

<i>Xanthoria borealis</i> R. Sant. & Poelt - All over Greenland, even the extreme high arctic areas	48,75,366
<i>X. elegans</i> (Link) Th. Fr. - All over Greenland, one of the most common epilithic lichens even in the high arctic areas	21,93,155,305,330
<i>X. soreliata</i> (Vainio) Poelt - All over Greenland, but usually less frequent and in smaller quantities at its localities than <i>Xanthoria elegans</i>	459

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THE CONIDIAL STATE OF SELINIA PULCHRA (ASCOMYCOTINA, HYPOCREALES)

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ABSTRACT

The anamorph of *Selinia pulchra*, isolated from cow dung, is described and illustrated, it is a *Tubercularia*-like conidial form. The entire life cycle -from conidium to ascospore- was reconstructed.

Key words: *Selinia pulchra*, Pyrenomycetes, anamorph, *Tubercularia*.

INTRODUCTION

Selinia is a coprophilous Pyrenomycete infrequently found on dung of cow, hare, horse or sheep.

Five species of *Selinia* have been described since Karsten (1876) erected the genus to accommodate *Hypocreopsis pulchra* Winter. Three species were described by Spegazzini: *S. antarctica* (1887), *S. intermedia* (1888) and *S. subtropica* (1909), but the last appears to be synonymous with *S. pulchra*, which has been redescribed by von Arx & Müller (1955) and Udagawa (1980). More recently, Khan and Krug (1989) have described *S. africana*.

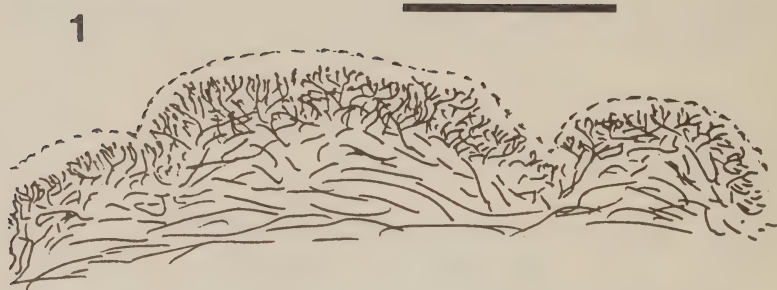


Fig. 1 *Selinia pulchra*: schematic section through sporodochium showing the arrangement of conidiophores and the slimy conidial mass (bar = 300 μ m).

in all of these descriptions of *Selinia* species, no data about a conidial stage were presented.

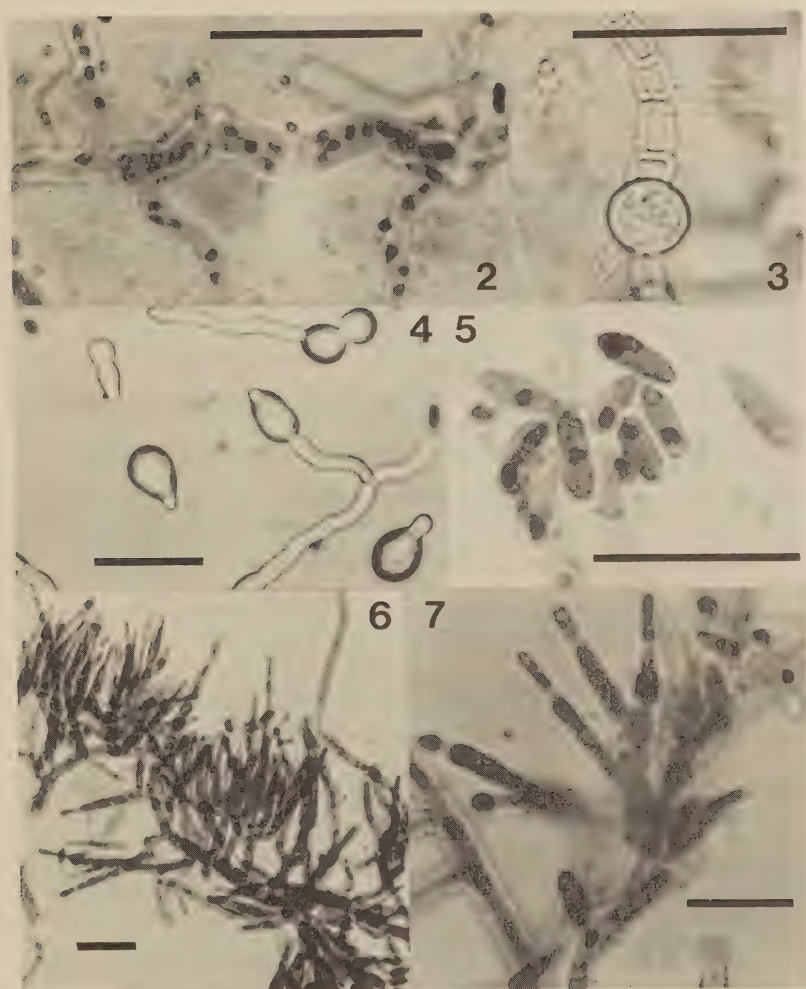
On the basis of well-known morphological characters, we conclude that *Selinia pulchra* has a *Tubercularia*-like anamorph.

Studies on ascocarp development and the cytology of the ascus are in progress.

RESULTS

Life cycle *in vitro*. From ascocarps developed on cow dung, *Selinia pulchra* ascospores were shot off on agar dishes (agar, 2 %), treated with NaOH (0.2 %) for 30 min, and incubated 24 hours. Single spore isolates were transferred to Yeast Extract Agar (YEA; yeast extract, 0.3 %, agar, 2 %). Sporodochia developed within 5-6 days at 20-24° C and continuous light. Conidia were collected with sterile water, poured on dishes with either YEA or GU (glucose, 1 %, urea, 0.05 %, agar, 2 %), and incubated 24 hs. From spontaneously germinating conidia, single conidium cultures were made on YEA and GU media. Incubation took place at 20-24° C, under continuous light. Sporodochia developed within 5-6 days and ascomata with fertile perithecia within 25-30 days, in both media.

Teleomorph. Stromata developed in culture -from single conidium isolates- were small, pulvinate, reddish brown, 2-5 x 1-3 mm, containing 1-6 immersed flask shaped perithecia, 500-650 μ m in diam., with dark reddish brown projecting ostioles, up to 250-300 μ m long. Asci 8-spored, clavate to ventricose, 150-230 x 45-60 μ m.



Figs. 2-7 *Selinia pulchra* 2 submerged mycelium with multinucleate cells, Giemsa, 3 chlamydospore, 4 germinating conidia, in vivo, 5 Giemsa stained conidia, 6 conidiophores, 7. phialides with conidia. (2-7 bar = 20 μ m).

Ascospores biseriate, hyaline to pale yellow, 1-celled, ellipsoid to fusiform, $45\text{--}55 \times 20\text{--}23 \mu\text{m}$, exospore thick and ornamented with small pits. Gelatinous covering present. The morphological characters described above are typical of *Selinia pulchra* as described previously (von Arx & Müller, 1955; Udagawa, 1980).

Anamorph. Colonies growing rapidly on Yeast Extract Agar at 23°C with vegetative mycelium either submerged or aerial, showing a clear concentric zonation, composed of two hyphal types: a) thin hyphae $2\text{--}6 \mu\text{m}$ diam., hyaline, septate, flexuous, profusely branched, with multinucleate cells, b) thick hyphae $6\text{--}12 \mu\text{m}$ diam., hyaline, mostly submerged, with light brown thick walls and broad septa, sparsely branched, frequently anastomosed, multinucleate cells (Fig. 2).

Sporodochia irregularly pulvinate, sparse or gregarious, pale yellow to bright orange, $0.7\text{--}3 \times 0.1\text{--}0.3 \text{ mm}$, developing from a thin subiculum with *textura intricata* (Fig. 1).

Conidiophores hyaline, $2\text{--}6 \mu\text{m}$ diam., arising from basal hyphae, $4\text{--}10 \mu\text{m}$ diam., repeatedly branched, multinucleate (Fig. 6).

Phialides cylindrical to clavate, $1.5\text{--}3.5 \times 6.5\text{--}13 \mu\text{m}$, acropleurogenously developed from conidiophores, with a distinct collar (Fig. 7).

Conidia hyaline, in a viscous slimy mass, 1-celled, uninucleate, ovoid to oblong, $2\text{--}4 \times 4.5\text{--}8 \mu\text{m}$ (Figs. 4, 5).

Chlamydospores developing occasionally in old cultures, intercalary, globose, $11\text{--}17 \mu\text{m}$ in diam., smooth to slightly punctate under light microscope, multinucleate (Fig. 3).

Habitat: on cow dung

Specimen examined: Argentina, Entre Ríos, Gualeguaychú leg. M. D. Bertonio (1988), BAFC 2345.

Remarks. The traditional concept of *Tubercularia* species is of sporodochial Hyphomycetes with acropleurogenously developing phialides producing ameroconidia in a dense slime (Barron, 1968; Carmichael et al., 1980; von Arx, 1981).

Seifert (1985) adopted a broader idea, with a polythetic concept, for the diagnosis of *Tubercularia*. In fact, he accepted *Tubercularia* species as sharing a combination of diverse characters, among them: conidiomata reacting to KOH. (Colour change of sporodochia tissue from yellow to vinose brown).

The sporodochia of the *Selinia pulchra* anamorph, under the described cultural conditions, lacks a sharp reaction to KOH.

If one ignores the pH mediated pigment changes, the anamorph of *S. pulchra* could be accepted as *Tubercularia sensu lato*.

Nevertheless, another question must be taken into account: the known teleomorphs of *Tubercularia* species are members of the *Nectria cinnabarina* group (Booth, 1959; Rossman, 1983). Obviously, *Selinia* is a fungus ontogenetically and morphologically far from the nectrioid fungi, occupying a taxonomic position near to *Hypocrea*.

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ROSELLINIA AND THAMNOMYCES IN MEXICO

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ABSTRACT

Ten taxa of *Rosellinia*, including three that remain herein unnamed, are described from Mexico. Cultures and anamorphs are described for *R. corticium* and *R. sublimbata*. The anamorph of *R. subiculata* is described from natural substrates. *Thamnomycetes chordalis* is reported.

KEY WORDS: *Geniculosporium*, *Rosellinia*, *Thamnomycetes*

In 1989 San Martín and Rogers published a preliminary account of *Xylaria* Hill ex Schrank in Mexico, followed by accounts of *Biscogniauxia* and *Camillea* (San Martín and Rogers, 1993A) and *Kretzschmaria*, *Leprieuria*, and *Poronia* (San Martín and Rogers, 1993B). Data were given on materials and methods and collecting sites in San Martín and Rogers (1993A); the reader is referred to that paper for such relevant data.

Rosellinia De Not.

Rosellinia includes mostly taxa with uniperitheciate stromata that are solitary to cespitose to confluent in small numbers. Stromata are usually superficial, subglobose or hemispherical or somewhat cylindrical, often partially embedded in, or surrounded by, a conspicuous subiculum. Ostioles are almost umbilicate to inconspicuously or conspicuously papillate. Stromatal surfaces are

smooth to wrinkled or warty. Perithecia are often thin-walled and can usually be lifted intact from a fractured stroma. Asci are more or less cylindrical, bearing an apical apparatus that is usually longer than wide, often more or less urn-shaped, and usually bluing in Melzer's iodine reagent. Ascospores are brown, inequilateral, often bearing a hyaline sheath and noncellular (secondary) appendages or slime caps at the apices. In addition, many species bear a cellular (primary) appendage at one or both ends that is embedded within the noncellular appendage when present. Anamorphs are referable to *Geniculosporium* Chesters & Greenhalgh and *Dematophora* R. Hartig.

The relatively few species of *Rosellinia* reported here surely represent only a fraction of the ultimate number present in Mexico. In particular, many more species are to be expected from moist subtropical and tropical regions. *Rosellinia*, however, is a genus that is not usually sought. Representatives are usually encountered during routine collecting. Indeed, most *Rosellinia* species are not known to be host-specific or geographically specific and, thus, purposeful collecting would probably be unrewarding.

Rosellinia is a taxonomically difficult genus because many taxa have been reported, among which are probably many synonyms. Petrini (1993) has done an outstanding job in elucidating and ordering taxa of the temperate zones. A treatment of taxa of the tropics would likewise be welcome.

KEY TO SPECIES OF *ROSELLINIA* FROM MEXICO

1. Subiculum present 2
1. Subiculum absent 7
 2. Ascospores usually not surrounded by a conspicuous hyaline sheath 3
 2. Ascospores usually surrounded by a conspicuous hyaline sheath 4
3. Stromata globose, 1-1.3 mm diam. Ostioles conical. Ascospores brown, ellipsoid-inequilateral to navicular, (16-)17-21 x 5.5-6(-7) μm , bearing a cellular appendage at one or both ends, with slime caps when in good condition *Rosellinia aquila*
3. Stromata subglobose, 0.5-1 mm broad. Ostioles finely papillate. Ascospores brown, ellipsoid-inequilateral with rounded ends, 11-13(-14) x 5-5.5(-6) μm , devoid of appendages or slime caps *Rosellinia subiculata*
4. Ascospores longer than 70 μm 5

4. Ascospores shorter than 70 μm 6
5. Stromata 0.8-1 mm diam, with smooth surface. Ostioles conic-papillate. Ascospores brown with narrowly rounded ends, (75-)83-102 x 10-13 μm , with straight germ slit spore-length or nearly so *Rosellinia procera*
5. Stromata 1.5-2 mm diam, with surface ornamented with polygonal brown scales. Ostioles papillate-hemispherical. Ascospores dark-brown with filamentous ends, (92-)95-161 μm long x 8-12(-13) μm broad in the middle x 1.5-2 μm broad at the ends, with straight germ slit much less than spore-length *Rosellinia bunodes*
6. Stromata globose, 1-1.3 mm diam. Ostioles conic-papillate. Ascospores dark-brown, ellipsoid-inequilateral to navicular, with a cellular appendage on one end at maturity, 23-27(-29) x (8.5-)9-10 μm , with straight germ slit spore-length or nearly so *Rosellinia corticium*
6. Stromata subglobose to pyriform, 0.8-1 mm broad. Ostioles conic-papillate. Ascospores brown to dark-brown, ellipsoid inequilateral to navicular, devoid of appendage at maturity, (35-)38-46 x (6.5-)7-7.5(-8) μm , with straight germ slit much less than spore-length *Rosellinia necatrix*
7. Stromata subglobose, perithecioid to several confluent, 0.5-1.5 mm long x 0.5-0.8 mm broad. Ascospores brown to dark-brown, ellipsoid-inequilateral to navicular, (8-)9-10(-11) x 4.5-5 μm , with straight germ slit slightly less than spore-length *Rosellinia* sp. (San Martín 170)
7. Ascospores longer. Combination of other characters differing from above 8
8. Stromata on dicot wood, globose, 0.5-0.9 mm diam, superficial, surface ornamented with wart-like plates and wrinkles. Ostioles umbilicate to slightly papillate surrounded by a disc ca. 0.1 mm diam. Ascospores dark-brown, ellipsoid-inequilateral to navicular with narrow to pinched ends, (13.5-)14-17 x (6-)6.5-7(-7.5) μm , with straight germ slit much less than spore-length *Rosellinia* sp. (San Martín 869)
8. Stromata on monocot wood, without conspicuous superficial ornamentation 9

9. Stromata globose, 0.6 mm diam. Ostioles conic-papillate. Ascospores brown-translucent with darker apices, fusoid, with abruptly acute, pinched or somewhat filamentous ends, (36.5-)37.5-47(-50) x (7-)7.5-10(-11) μm , with oblique germ slit much less than spore-length
 *Rosellinia* sp. (San Martín 762)
9. Stromata globose, 0.5-0.8 mm diam. Ostioles obscure to slightly papillate. Ascospores brown to dark-brown, ellipsoid-inequilateral to navicular with rounded ends, surrounded by a hyaline sheath, (15-)16-19(-20.5) x (6.5-)7-8(-8.5) μm , with straight germ slit spore-length
 *Rosellinia sublimbata*

Rosellinia aquila (Fr.:Fr.) De Not., Sfer. ital. 21, t.18.1863. Figs. 1-4.
 Teleomorph is largely as described by Kirschstein (1933) and Shear (1941).

Stromata perithecioid, scattered to densely aggregated, globose, 1-1.3 mm diam x 0.8-1 mm high, superficial, with abundant purplish-brown, shiny subiculum encasing lower part of stromata; externally dark-brown to blackish, internally black. Texture hard. Surface smooth. Perithecia 0.9-1 mm broad, papyraceous, somewhat collapsed when dry. Ostioles papillate-conical. *Asci* cylindrical, eight-spored, with spore arrangement uniseriate to partly biseriate, short-stipitate, 113-139 μm total length x 6-7 μm broad, the spore-bearing part 80-105 μm , with apical ring bluing in Melzer's iodine reagent, urn-shaped, 5-5.5 μm high x 4(-4.5) μm broad. *Ascospores* brown, ellipsoid inequilateral to navicular with rounded to more or less narrow ends, (16-)17-21 x 5.5-6(-7) μm , with one cellular, hyaline appendage at each end ca. 1.5 μm long, with straight germ slit slightly less than spore-length on convex side.

SPECIMEN EXAMINED: Nuevo León state, Santiago municipality, La Ciénega, El Salto, VIII.88, San Martín 1006, on wood in submontane scrub with *Quercus* spp. (ITCV;JDR).

NOTES: The anamorph was described by Greenhalgh and Chesters (1968). The stromatal characteristics and presence of two cellular appendages on the ascospores of this collection agree with Kirschstein's notes (1933) on *R. aquila*. The size of the spores is the same as reported from type and Texas material by Shear (1941). Our material fits Petrini's concept (1993), but asci of our material are shorter. In her opinion ascospores of *Rosellinia* species show a wide variation in size, with spore morphology being more diagnostic.

Rosellinia aquila is a close relative of *R. corticium*. In the northeastern state of Nuevo León *R. corticium* was found on *Quercus* sp. at altitudes not higher than 1000 meters, while *R. aquila* was found on an unknown host (perhaps *Fraxinus*) at altitudes of 1500-2000 meters.

Rosellinia bunodes (Berk. & Broome) Sacc., Syll. Fung. 1, p. 254. 1882.

Teleomorphic stromata are much as described by Saccas (1956). *Asci* cylindrical, not intact in our material, eight-spored, with biseriate spore arrangement, spore-bearing part 350-416 μm , with apical ring bluing in Melzer's iodine reagent, rectangular, 20-25 μm high x 8-10 μm broad. *Ascospores* surrounded by a hyaline sheath, (92-)95-161 μm long x 8-12(-13) μm broad in the middle x 1.5-2 μm broad at the ends, with straight germ slit much less than spore-length.

SPECIMEN EXAMINED: Chiapas state, Ocosingo municipality, Montes Azules Biosphere Reserve, 28.V.88, San Martín 808, on dicot wood in evergreen tropical rain forest (ITCV;JDR).

NOTES: The gross morphology of this fungus is much as depicted by Saccas (1956) and Sivanesan and Holliday (1972) for *Rosellinia bunodes*, but differs in the presence of a hyaline sheath surrounding ascospores, and in larger ascospores. There are at least two other species reported with stromatal morphology similar to the fungus reported herein, i.e., *Rosellinia echinata* Masee and *Rosellinia zingiberi* Stevens & Atienza, both considered by Sivanesan and Holliday (1972) to be synonyms of *Rosellinia bunodes*. Until type material of the three species mentioned above can be studied, and more information on fungi related to *R. bunodes* obtained, the Mexican collection is considered to be *R. bunodes*.

Martin (1967) considered this species to be *Hypoxyylon bunodes* (Berk. & Broome) P. Martin.

Rosellinia corticium (Schwein.:Fr.) Sacc., Syll. Fung. 1, p. 253. 1882.

Fig. 5.

Stromata perithecioid, solitary to confluent, often densely aggregated, globose, with rounded to somewhat flattened top, 1-1.3 mm diam x 0.8-1 mm high, superficial, with abundant purplish-brown, shiny subiculum encasing 1/2 to 3/4 of stromata; externally dark-brown, internally black. Texture rather hard. Surface smooth. Perithecia 0.9-1.2 mm broad, papyraceous, collapsed when dry. Ostioles papillate-conical, surrounded by a blackish halo. *Asci* cylindrical, eight-spored, with uniseriate spore arrangement, stipitate, 190-218 μm total length x 11-12(-13) μm broad, the spore-bearing part 140-158 μm , with apical ring bluing in Melzer's iodine reagent, rectangular, 10-11 μm high x 5-6 μm broad. *Ascospores* brown to dark-brown, ellipsoid-inequilateral to navicular with rounded to narrowly rounded ends, 23-27(-29) x (8.5-)9-10 μm , surrounded by a hyaline sheath and with a cellular, hyaline appendage at one end ca. 1.5 μm long x 2 μm broad, with straight to sigmoid germ slit slightly less than spore-length on convex side.

Colonies covering Petri dish in 1-2 wk, at first white, felty, azonate, with margins somewhat plumose, then white-grayish, floccose, with entire margins, grooved at the edges. Reverse unchanged. Conidium-bearing structures produced over the entire surface of colony. *Conidiophores* erect,

dichotomously branched, without well-defined main axes, light-brown. *Conidiogenous cells* of indeterminate growth, cylindrical, geniculate, 16-47 x 3-4 μm , hyaline, bearing terminal and lateral, poroid to denticulate conidial secession scars. *Conidia* hyaline (olivaceous in mass), ellipsoid to cylindroid, (4-)5-12 x (3-)3.5-4 μm , with flattened bases indicating former points of attachment to conidiogenous cell.

SPECIMENS EXAMINED: Nuevo León state, Santiago municipality, El Cercado, 26.VI.88, Moreno 218 & 223 (CULTURED), on *Quercus* sp. wood in submontane scrub with *Quercus* spp. (ITCV;JDR); 23.X.88, San Martín 1150 (same data as Moreno collections above) (ITCV;JDR).

NOTES: Mexican material fits Petrini's concept (1993) of *R. corticium*. Martin (1967) reported *Rosellinia corticium* (as *Hypoxylon corticium*), from Mazatlán, Sinaloa, in México. The anamorph is referable to Geniculosporium.

Rosellinia necatrix Prilleux, Bull. Soc. Mycol. France 20:34. 1904.

The teleomorph is much as described by Saccas (1956). Ascus apical ring bluing in Melzer's iodine reagent, coffin-shaped, 9-10 μm high x 6.5-8 μm broad. *Ascospores* brown to dark-brown, ellipsoid-inequilateral to navicular with narrow to somewhat pinched ends, (35-)38-46 x (6.5-)7-7.5(-8) μm , with straight germ slit much less than spore-length on flattened side, some surrounded by a hyaline sheath.

SPECIMENS EXAMINED: Chiapas state, Ocosingo municipality, Ejido Boca de Chajul, 28.V.88, San Martín 816, on wood in evergreen tropical rain forest (ITCV;JDR). Oaxaca state, Temazcal town, 8.IX.88, San Martín 1115, on wood in subevergreen tropical rain forest (ITCV;JDR).

NOTES: Mexican material fits well Petrini's description (1993) and Saccas' description (1956) for *R. necatrix* from Africa. According to Francis (1985) American collections assignable to *R. necatrix* (R. Hartig) Berl. are strikingly similar to type material of *R. bothrina* (Berk. & Broome) Sacc., a fungus said to differ from *R. necatrix* in thriving in tropical areas and in having a sheath on the ascospores. More detailed studies are needed in order to clarify the nomenclatural status of the often-encountered *R. necatrix*. According to Francis (1985) and Petrini (1993) the type of *R. necatrix* is lost; the species should be neotypified.

Martin (1976) considered this species as *Hypoxylon necatrix* (R. Hartig) P. Martin.

Rosellinia procera Syd. and P. Syd., Ann. Mycol. 8:37. 1910. Figs. 16-18.

Stromata perithecioid, densely gregarious, enclosing one to several perithecia, globose, 0.6-1 mm diam x 1-1.5 mm high, with lower part embedded in a dense, brown metallic subiculum; externally and internally black. Texture carbonous. Surface smooth. *Perithecia* 0.6-0.9 mm diam. Ostioles obscure to prominently conic-papillate. *Asci* cylindrical, eight-spored, with partly biserial spore arrangement, short-stipitate, 293-345 μm total length x 19-

24 μm broad, the spore-bearing part 283-323 μm , with apical ring bluing in Melzer's iodine reagent, rectangular, 13-15 μm high x 8.5-10 μm broad. *Ascospores* dark-brown, ellipsoid-inequilateral to somewhat crescentic with narrow ends, surrounded by a hyaline sheath clearly visible at apices, (75-)83-102 x 10-13 μm , with straight germ slit spore-length.

SPECIMENS EXAMINED: Chiapas state, Ocosingo municipality, Montes Azules Biosphere Reserve, 28.V.88, San Martín 810 & 852, on dicot wood in evergreen tropical rain forest (ITCV;JDR); Palenque municipality, Palenque Ruins, 2.VI.88, San Martín 873, on dicot wood in evergreen tropical rain forest (ITCV;JDR). Oaxaca state, Temazcal town, 7.X.88, San Martín 1066, on dicot wood in median subevergreen tropical rain forest (ITCV;JDR).

ADDITIONAL SPECIMEN EXAMINED: *Rosellinia procera* Syd.: PHILIPPINES: Los Baños, 10.XI. 1913, L. Baker 201 (S).

NOTES: Mexican material fits well the description of *Rosellinia procera*. Type material was not located at S. *Rosellinia megalosperma* Syd. & P. Syd. is probably a later synonym of *R. procera*.

Rosellinia sp. (San Martín 170).

Stromata superficial, 0.5-1.5 mm long x 0.5-0.8 mm broad, enclosing one to 2-6 perithecia, subglobose; externally shiny-black, internally black, with dark-brown to blackish basal stromatic material. Texture carbonous. Surface smooth. *Perithecia* 0.3-0.4 mm diam. Ostioles slightly papillate to papillate-conical, some surrounded by a poorly-defined disc. *Asci* cylindrical, eight-spored, stipitate, 99-127 μm total length x 5-6 μm broad, the spore-bearing part 55-80 μm , with apical ring bluing in Melzer's iodine reagent, quadrate, flared upward, 1-1.5 μm high x 2-2.5 μm broad. *Ascospores* brown to dark-brown, ellipsoid-inequilateral to navicular, with narrow to rounded ends, (8-)9-10(-11) x 4.5-5 μm , with straight germ slit slightly less than spore-length on concave side.

SPECIMEN EXAMINED: Quintana Roo state, Othón P. Blanco municipality, San Felipe Bacalar, 7.XII.86, San Martín 170, on wood in an acahual (ITCV;JDR).

NOTES: This fungus is not known to us.

Rosellinia sp. (San Martín 762).

Figs. 6-9.

Stromata perithecioid, scattered, subglobose, 0.6 mm diam, superficial, without subiculum; externally at first covered with a whitish layer (a parasite?) then shiny-black, internally black. Texture hard. Surface smooth. *Perithecia* globose 0.5-0.6 mm diam. Ostioles papillate-conical, prominent. *Asci* cylindrical, not intact in our material, with apical ring bluing in Melzer's iodine reagent, coffin-shaped, 10-12(-13) μm high x (5-)5.5-6(-7) μm broad. *Ascospores* brown, translucent, crescentic, with pinched to more or less filamentous apices darker than spore body, (36.5-)37.5-47(-50) x (7-)7.5-10(-11) μm , with oblique germ slit, much less than spore-length on flattened side.

SPECIMEN EXAMINED: Chiapas state, Ocosingo municipality, Ejido Boca de Chajul, 27.V.88, San Martín 762, on monocot stem in evergreen tropical rain forest (ITCV;JDR).

NOTES: We cannot identify this fungus. It is much like the following specimen: BRITISH WEST INDIES: Trinidad, Maraval Valley, 1913, Thaxter, R., on monocot (FH;JDR). *Rosellinia desmazieresii* (Berk & Broome) Sacc. (as "desmazierii") seems very close but has a subiculum (Francis, 1985). Likewise, *desmazierii* var. *acutispora* Theiss. described by Theissen (1908) seems close to Mexican material, but is said to have a subiculum.

Rosellinia sp. (San Martín 869).

Figs. 19-21.

Stromata perithecioid, densely aggregated, globose, 0.5-0.9 mm diam, superficial, without subiculum; externally dark-brown to black, internally black. Texture brittle, fragile. Surface ornamented with wart-like plates and wrinkles except around the ostioles. *Perithecia* 0.4-0.7 mm diam. Ostioles umbilicate to slightly papillate, surrounded by a raised disc ca. 0.1 mm diam. *Asci* cylindrical, eight-spored, with uniseriate spore arrangement, stipitate, 150-184 μm total length x 8-10 μm broad, the spore-bearing part 90-99 μm , with apical ring bluing in Melzer's iodine reagent, rectangular, 3 μm high x 4 μm broad. *Ascospores* dark-brown with blackish ends, ellipsoid-inequilateral to navicular, with narrow to pinched ends, (13.5-)14-17 x (6-)6.5-7(-7.5) μm , with straight germ slit much less than spore-length on flattened side.

SPECIMEN EXAMINED: Chiapas state, Ocosingo municipality, Montes Azules Biosphere Reserve, 30.V.88, San Martín 869, on dicot wood in evergreen tropical rain forest (ITCV;JDR).

NOTES: This fungus is unknown to us. It is possibly not even a *Rosellinia*. If so, it would be accommodated in Petrini's subgenus *Corrugata* (Petrini, 1993). A name for this fungus awaits detailed study of tropical *Rosellinia*.

Rosellinia subiculata (Schwein.:Fr.) Sacc., Syll. Fung. 1, p. 255. 1882.

Figs. 13-15.

Stromata perithecioid, scattered to 2-3 confluent, subglobose, flat-topped, partially sunken in the wood, 0.5-3 mm long x 0.5-1 mm broad x 0.5-0.7 mm high, with cream to white subiculum; externally shiny-black, internally dull black. Texture very hard. Surface smooth. *Perithecia* subglobose, 0.8-0.9 mm broad. Ostioles discrete, finely papillate. *Asci* cylindrical, eight-spored, with uniseriate to partly biseriate spore arrangement, very long-stipitate, 140-211 μm total length x 6-6.5 μm broad, the spore-bearing part 71-80 μm , with apical ring bluing in Melzer's iodine reagent, rectangular, flared upward, 2 μm high x 2.5-3 μm broad. *Ascospores* brown, ellipsoid-inequilateral with rounded ends, 11-13(-14) x 5-5.5(-6) μm , with straight germ slit slightly less than spore-length on flattened side.

Anamorph in nature *Geniculosporium*-type. Mycelia grayish to greenish, covering some mature teleomorphic stromata. *Conidiogenous cells* of

indeterminate growth, brownish, with poroid conidial secession scars. *Conidia* subglobose, hyaline to subhyaline, (2-)2.5-4 x 2-3 μm , with flattened bases indicating former points of attachment to conidiogenous cell.

SPECIMEN EXAMINED: Veracruz state, Jalapa, Coapexpan, 17.VIII.87, San Martín 990B, on decorticated dicot wood in an oak-pine forest (XAL;ITCV;JDR).

NOTES: The Mexican fungus fits Petrini's concept (1993) of *Rosellinia subiculata* except for longer asci in our material. In her opinion, *R. subiculata* normally has a sulfur-yellow subiculum, but it can be white or absent in some collections. The Mexican collection has a cream to white subiculum. The anamorph is largely as described by Rogers (1985) from culture.

Rosellinia sublimbata (Durieu & Mont.) Pass. apud Thüm., Contr. Fl. Lusit. 2:33:1879. Figs. 10-12.

Stromata perithecioid, erumpent, hemispherical, 0.5-0.9 mm diam, enclosing 1 to 2-3 perithecia, with bases surrounded by a black, stromatic material; externally at first brown then blackish, internally blackish. Texture hard. Surface smooth to somewhat verrucose. *Perithecia* 0.3-0.4 mm diam. Ostioles obscure to slightly papillate. *Asci* cylindrical, eight-spored, 117-156 μm total length x 10-12 μm broad, the spore-bearing part 100-125 μm , with apical ring bluing in Melzer's iodine reagent rectangular, 5.5-7 μm high x 4-5 μm broad. *Ascospores* brown to dark-brown, ellipsoid-inequilateral to navicular with rounded ends, with a hyaline sheath thickened on the ventral side, (15-)16-19(-20.5) x (6.5-)7-8(-8.5) μm , with straight germ slit spore-length or nearly so on flattened side.

Colonies covering Petri dish in 2-3 wk, at first white then with shades of yellow, velvety, somewhat zonate, with entire margins. Reverse unchanged. Conidium-bearing structures produced on discrete areas of the colony as blackish tufts. *Conidiophores* not differentiated. *Conidiogenous cells* short, hyaline, somewhat coiled, 8-10 x 2.5-3 μm , single or in whorls produced laterally or terminally on apparently unspecialized hyphae, bearing denticulate conidial secession scars. *Conidia* produced holoblastically in apparently sympodial sequence. *Conidia* hyaline, smooth, ellipsoid to cylindroid, (6-)7-9 x 3.5-4 μm , with flattened bases indicating former points of attachment to conidiogenous cell.

SPECIMENS EXAMINED: Chiapas state, Ocosingo municipality, Ejido Boca de Chajul, 27.V.88, San Martín 777, culm of "caña brava," on shore of Lacatún River (ITCV;JDR); Quintana Roo state, Othón P. Blanco municipality, Ejido La Unión, 12.XI.88, San Martín 1309, culm of "carrizo" in subevergreen tropical rain forest (ITCV;JDR); Tamaulipas state, Gómez Farfás town, 2.IX.88, San Martín 1019 (CULTURED), on wood of the monocot "carricillo" in median subdeciduous tropical rain forest (ITCV;JDR).

ADDITIONAL SPECIMEN EXAMINED: ALGERIA: no. 36, culm of *Arundo mauritanica* (K; TYPE of *Sphaeria sublimbata*).

NOTES: This fungus is *Rosellinia sublimbata* (Ju and Rogers, IN PRESS). It also is morphologically similar to *Rosellinia dimidiata* Starb., an inhabitant of *Smilax* sp. (Ju and Rogers, IN PRESS). *Rosellinia amblystoma* Berl. & F. Sacc. is a probable synonym (Ju and Rogers, IN PRESS; Petrini, 1993). The anamorph is much as described by Petrini, 1993, but our conidia are slightly larger than those described by Ju and Rogers (IN PRESS).

Thamnomycetes chordalis Fr., Linneana 5:534. 1830; Fr.:Fr., Syst. Mycol. Index, p. 184. 1832.

The teleomorph is as described by Samuels and Müller (1980). The anamorph, assigned to *Nodulisporium* Preuss, was obtained in culture by Samuels and Müller (1980).

SPECIMEN EXAMINED: Chiapas state, Palenque municipality, Palenque Ruins, 8.XI.88, San Martín 1442 (CULTURED), on wood in evergreen tropical rain forest (ITCV;JDR).

NOTES: This species, apparently rare in Mexico, matches well the description and figure given by Dennis (1957) (as *Thamnomycetes rostratus* Mont.), and by Samuels and Müller (1980). Cultures of the Mexican fungus did not yield the anamorph.

Figs. 1-21. *Rosellinia* species. 1-4. *Rosellinia aquila*. Fig. 1. Ascospore with one cellular appendage at each end (arrow). x 2050. Fig. 2. Ascospore with straight, ventral germ slit. x 2050. Fig. 3. Ascus apical ring. x 2400. Fig. 4. Young ascospore with a cellular appendage at each end (arrows) and a noncellular appendage on one end (right arrow). x 2050. Fig. 5. *Rosellinia corticium*: ascospore with hyaline sheath and a cellular appendage at one end (arrow). x 2050. Figs. 6-9. *Rosellinia* sp. (San Martín 762). Fig. 6. Ascus apical ring. x 2050. Fig. 7. Ascospores. x 600. Fig. 8. Ascospore. x 900. Fig. 9. Ascospore with short, oblique germ slit. x 1550. Figs. 10-12. *Rosellinia sublimbata*. Fig. 10. Ascospore with hyaline sheath. x 1900. Fig. 11. Ascus apical ring. x 2200. Fig. 12. Ascospore with ventral germ slit. x 2000. Figs. 13-15. *Rosellinia subiculata*. Fig. 13. Ascospore. x 2350. Fig. 14. Ascospore with ventral germ slit. x 2350. Fig. 15. Ascus apical ring. x 2350. Figs. 16-18. *Rosellinia procera*. Fig. 16. Ascospores. x 650. Fig. 17. Ascospore hyaline sheath (arrow). x 1550. Fig. 18. Ascus apical ring. x 1750. Figs. 19-21. *Rosellinia* sp. (San Martín 869) Fig. 19. Ascospores. x 2050. Fig. 20. Ascospore with straight, short germ slit on ventral side. x 2050. Fig. 21. Ascus apical ring. x 2050.

Figs. 1,4,5,10 and 17 by differential interference contrast microscopy, all others by brightfield microscopy.

Figs. 3,6,11,15,18 and 21 from mounts in Melzer's reagent, the rest from mounts in water.



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***PLACOPYRENIUM BUCEKII* ET REMARQUES SUR LES VERRUCARIAACEAE (VERRUCARIALES, LICHENES)**

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Résumé: *Placopyrenium bucekii* (Nádv. et Serv.) Breuß, récemment découvert dans le sud-est de la France (Provence, massif des Maures, département du Var), est étudié du point de vue morphologique, anatomique, chorologique et écologique, et comparé avec les autres Verrucariaceae d'Europe occidentale, notamment en ce qui concerne la déhiscence des asques et la structure des pycnides.

Resumo: *Placopyrenium bucekii* (Nádv. et Serv.) Breuß, frešdate malkovrita en SE-Francio (Provenco, montaro Maures, departamento Var) estas studita morfologie, anatomie, disvastiĝe k ekologie k komparita kun la aliaj Verrucariaceae de Okcidenta Eŭropo, i. a. laŭ aska dehisko k piknidia strukturo.

Summary: *Placopyrenium bucekii* (Nádv. et Serv.) Breuß, recently discovered in SE of France (Provence, Maures mountain, Var department) is studied concerning morphology, anatomy, chorology and ecology and compared with other Verrucariaceae of western Europe, notably for ascal dehiscence and pycnidial structure.

Introduction

Au cours de l'étude écologique des groupements lichéniques saxicoles calcifuges du sud-est de la France, nous avons découvert près du Muy (Var, massif des Maures, Provence), un lichen crustacé peu connu, ne figurant pas dans les flores d'OZENDA et CLAUZADE (1970) et de CLAUZADE et ROUX (1985), *Placopyrenium bucekii* (Nádv. et Serv.) Breuß, découverte brièvement mentionnée par BRICAUD et al. (1992). Il est abondant sur la montagne de Roquebrune (communes du Muy et de Roquebrune-sur-Argens), sur des surfaces rocheuses non calcaires, où l'eau ruisselle plus ou moins longtemps après les pluies.

Cette espèce, décrite depuis longtemps par NADVORNIK et SERVÍT (in SERVÍT 1936) sous le nom de *Dermatocarpon bucekii* a été récemment placée par BREUSS (in NIMIS et POELT 1987) dans le nouveau genre *Placopyrenium* O. Breuß, dont elle constitue l'espèce type. La description de cet auteur se limitant à une diagnose du genre, non illustrée, et à la mention de deux espèces (*P. bucekii* et *P. trachyticum*), nous donnons ici une description détaillée de *P. bucekii*, basée sur l'abondant matériel récolté dans le sud de la France continentale et sur quelques spécimens trouvés en Corse, en Grèce et à Chypre.

Méthodes d'étude

Les coupes microscopiques ont été réalisées à main levée et observées dans l'eau, le bleu de crésyl (BCr), le lugol (I), une solution aqueuse d'hydroxyde de potassium à 10% (K), une solution alcoolique de paraphénylène diamine-base (P) et le bleu au lactophénol (bleu coton dans le lactophénol: BLF), avec un microscope optique (grandissement maximal de x1500). Dans la mesure du possible, du matériel frais a été observé, mais comme certains spécimens étudiés sont anciens, les mesures, pour être comparables, ont toutes été effectuées dans l'eau, sur du matériel mort. Les dessins ont été réalisés avec l'aide d'un tube à dessin et, sauf indication contraire, à partir de spécimens provençaux.

Dans l'expression des dimensions des squamules, des spores et des conidies, la moyenne est indiquée en italique, encadrée par les valeurs extrêmes après élimination des 10% des valeurs les plus élevées et des 10% des valeurs les plus faibles, tandis que les valeurs extrêmes absolues sont placées entre parenthèses.

Sauf exceptions, la nomenclature adoptée est celle de CLAUZADE et Roux (1985, 1987 et 1989). Les auteurs des taxons cités ne sont pas

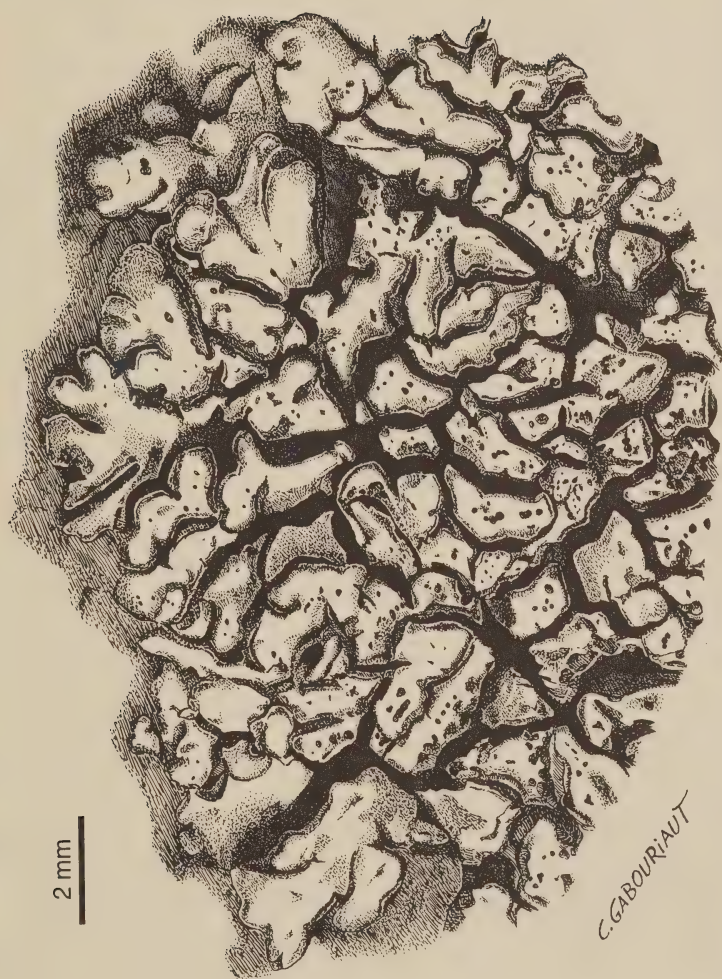
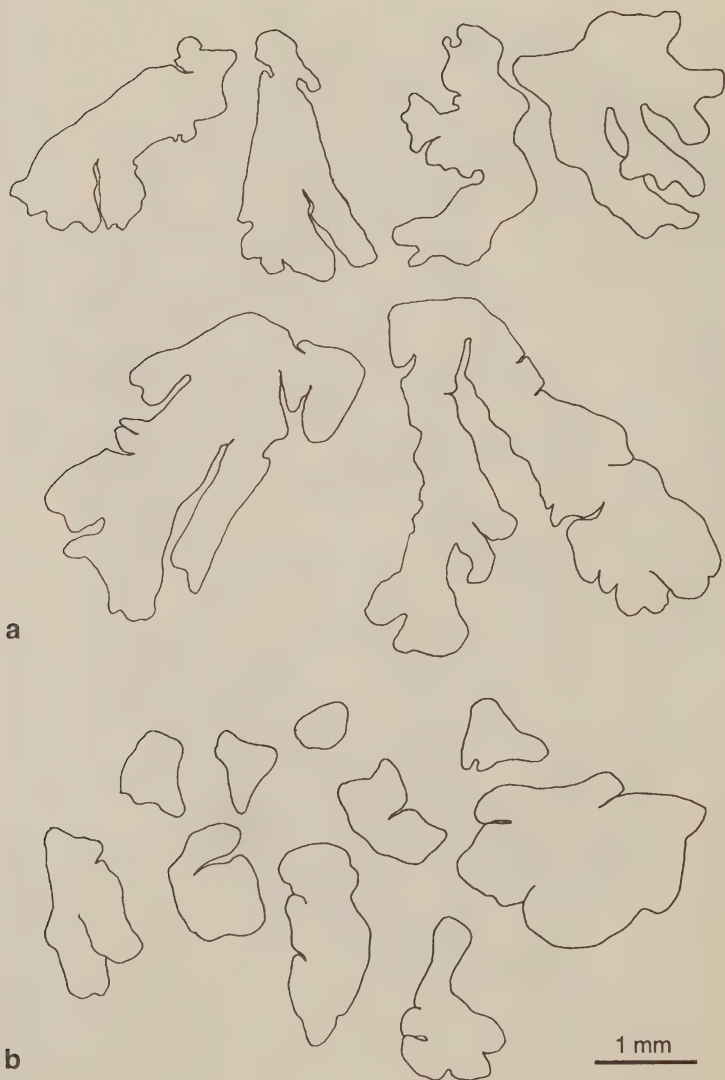


Fig. 1 — Morphologie externe de *Placopyrenium bucekii* observé au stéréomicroscope, montrant la partie externe lobée et la partie interne non lobée, fertile. Dessin de C. GABOURIAUT.

mentionnés, sauf lorsque la nomenclature de CLAUZADE et ROUX n'a pas été suivie.



Description

I — Thalle

A. Morphologie externe (fig. 1–2)

Le thalle épilithique, squamuleux–aréolé, envahissant quelquefois divers thalles crustacés [*Verrucaria* spp., *Staurothele fissa* (incl. *S. bazslinszkyi*) et parfois son propre thalle], d'un gris assez clair, est formé de squamules rayonnantes à la périphérie, qui, le plus souvent, donnent à l'ensemble du thalle un aspect nettement lobé. Le thalle forme une rosette de dimensions variables (de 1 cm² à plusieurs dizaines de cm²), circulaire ou plus ou moins allongée lorsqu'il suit la microtopographie de la roche. La morphologie des squamules diffère selon leur position dans le thalle.

Les squamules centrales, à contour plus ou moins rectangulaire ou polygonal, de (0,3)0,4–1,2–2,3(2,6) × (0,2)0,3–0,8–1,5(1,6) mm (d'après 40 mesures), ne sont pas lobées. Elles sont recouvertes d'une pruine blanche donnant au thalle un aspect grisâtre à l'oeil nu. La surface de ces squamules paraît très finement sillonnée, les sillons étant disposés parallèlement au sens d'allongement de la squamule. L'étude structurale du thalle (section B) montre que ces alignements correspondent à des cellules corticales mortes. À l'état humide, la squamule prend une couleur brun foncé avec des nuances cuivrées. À l'état sec, la couleur blanchâtre de la pruine est donc due à une diffusion de la lumière par réflexion sur les cellules corticales mortes.

Les squamules périphériques de (1)1,5–2,3–3,2(4,1) × (0,3)0,4–0,6–1(2) mm (d'après 40 mesures) sont plus allongées et lobées, voire digitées à leur extrémité. Les lobes sont peu adhérents au substrat à leur extrémité et ont parfois tendance à se chevaucher. La pruine des squamules périphériques est identique à celle des squamules centrales, mais, en plus, elle a tendance à former de petits amas floconneux dispersés, donnant une teinte plus claire à la périphérie du thalle. Des squamules de type lobé se rencontrent parfois au centre du thalle et correspondent peut-être à de jeunes thalles se développant sur le thalle adulte.

Fig. 2 — Diversité des squamules de *Placopyrenium bucekii*. a) Squamules périphériques, lobées. b) Squamules internes, non lobées, parfois un peu lobulées.

Les thalles de petites dimensions sont essentiellement constitués de squamules allongées, de type périphérique. Les squamules rectangulaires ou polygonales, de type central, n'apparaissent que chez les thalles de dimension plus grande.

Qu'elles soient centrales ou périphériques, les squamules sont légèrement concaves ou planes, rarement légèrement convexes (spécimens de Chypre) et possèdent un épais rebord noir très caractéristique, se distinguant particulièrement sur le pourtour du thalle du fait du grand contraste de teinte avec le reste de la squamule.

La face inférieure des squamules est brun noir. La fixation ne se fait pas sur toute la surface inférieure, mais ponctuellement, sous forme de pédoncules courts et larges, peu nombreux (1–5 par squamule).

B. Structure (fig. 3 à 5)

L'étude microscopique de la structure du thalle à partir de coupes verticales montre, du haut vers le bas, la disposition suivante :

1 – Cortex supérieur rudimentaire (pseudocortex)

Il est formé de 1 à 3, parfois 5 (et même jusqu'à 9 sur un spécimen de Chypre) assises cellulaires, les 3 supérieures pigmentées de brun pâle, forment un pseudoparenchyme (*textura angularis*), et sont surmontées d'une couche nécrale formée de cellules mortes et pleines d'air. L'ensemble a une épaisseur de 9 à 40 μm (y compris la couche nécrale de 3–9 μm).

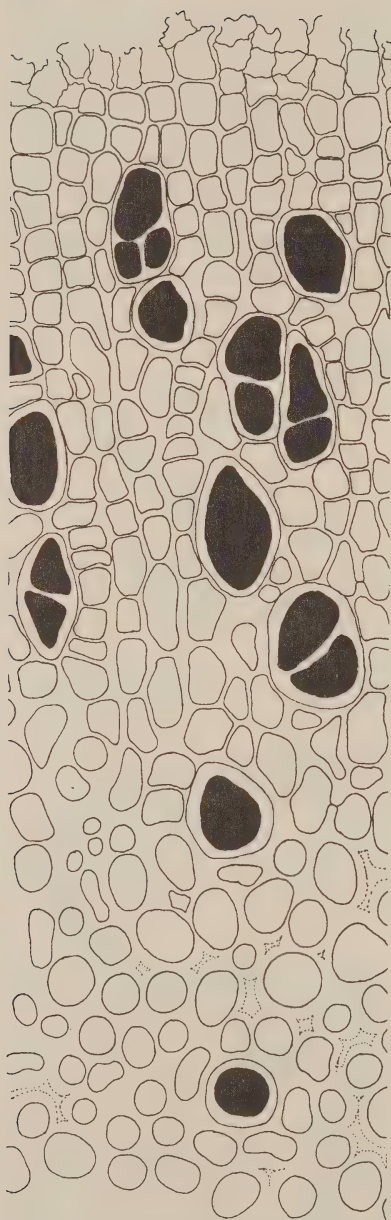
En lumière polarisée, la couche nécrale apparaît biréfringente à cause de l'air contenu dans les cellules et non à cause de cristaux comme un examen superficiel pourrait le laisser croire ; elle perd cette biréfringence lorsque l'air est chassé des cellules mortes, par exemple par addition

Fig. 3 — Coupes transversales d'une squamule périphérique (a) et d'une squamule interne (b) de *Placopyrenium bucekii*, vues à un faible grossissement et montées dans l'eau. De haut en bas : cortex supérieur, formé de deux couches : couche nécrale (en grisé) et couche vivante ; couche algale, à cellules algales, plus ou moins alignées verticalement (ronds noirs) ; médulle, à cellules algales encore présentes dans la moitié supérieure, mais moins nombreuses que dans la couche algale et non orientées. Les deux types de squamules se prolongent vers le bas par un pédoncule fixateur, dont seule la base est visible chez a. La squamule b, beaucoup plus large que la squamule a, porte un périthèce.

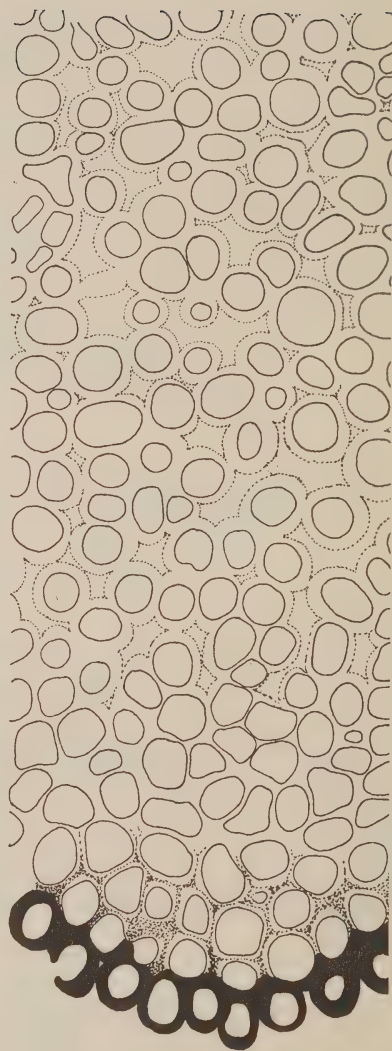
d'alcool éthylique à la préparation. Cette couche est à l'origine de la pruine, en diffusant la lumière qui se réfléchit sur les cellules mortes.

Les cellules de ce cortex supérieur rudimentaire, subquadrangulaires ou même subrectangulaires sur une coupe verticale, de $1,5-9 \times 1,5-6 \mu\text{m}$, à paroi mince ($<0,5 \mu\text{m}$) ne se distinguent de celles de la couche algale sous-jacente que par la présence d'un pigment brun clair, localisé dans la paroi et d'aspect amorphe. Le passage du cortex à la couche algale se fait insensiblement. D'ailleurs, des cellules algales mortes, plus rarement vivantes, s'observent çà et là jusqu'au sommet du cortex qui correspond donc à un pseudocortex ("Scheinrinde", POELT 1958).





4a



10 μ m

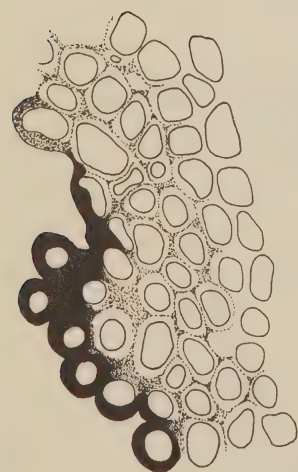
4b

2 — Couche algale

Discontinue, épaisse de 40–100 μm (jusqu'à 200 μm sur le matériel de Chypre), formée de 10–15 couches de cellules (1,5–10 $\times$ 1,5–7 μm) subquadrangulaires ou même subrectangulaires sur une coupe verticale, toutes jointives, formant un pseudoparenchyme (textura angularis passant à une textura prismatica). Les cellules algales (3,5–10 $\times$ 3,5–8 μm), de type protococcoïde, sont assez distinctement alignées verticalement, tout comme d'ailleurs les hyphes qui les entourent.

3 – Médulle

De 80–250 μm d'épaisseur (jusqu'à 550 μm sur le matériel de Chypre), subparaplectenchymateuse (présentant de petits méats), elle est formée de cellules (3–12 $\times$ 3–8 μm) nettement arrondies, globuleuses ou subglobuleuses (textura globulosa), à paroi plus épaisse (0,5–1,5 μm) que dans le pseudocortex et la couche algale. Toutefois, d'assez nombreuses cellules algales persistent dans la partie supérieure de cette médulle. Enfin, la médulle est souvent plus épaisse dans les squamules centrales que dans les squamules périphériques.



4c

10 μm

Fig. 4 — Structure microscopique fine du thalle de *Placopyrenium buceki* d'après la coupe transversale d'une squamule centrale colorée par le bleu au lactophénol. a) Cortex supérieur (couche nécrale et couche vivante), couche algale (ronds noirs : cellules algales) et sommet de la médulle (à cellules algales peu nombreuses et cellules fongiques arrondies, à paroi épaissie, souvent séparées par de petits méats). b) Partie inférieure de la médulle (dépourvue de cellules algales) et cortex inférieur, pigmenté. c) Cortex latéral, en continuité avec le cortex inférieur et à structure semblable à celui-ci.

4 – Cortex inférieur et latéral

Les faces inférieures et latérales, en contact avec le substrat ou d'autres squamules, sont couvertes de 3 à 5 couches de cellules globuleuses ou subglobuleuses, à paroi épaisse (0,5–2 μm), pigmentée de brun (pigment localisé dans la paroi des cellules, sous forme de granules brun sombre). Seule la couche la plus externe est fortement pigmentée : les granules pigmentaires sont beaucoup plus diffus dans les autres couches. Ces cortex inférieur et latéral, peu différenciés de la médulle, sont paraplectenchymateux (textura globulosa), dépourvus de méats.

En conclusion, le thalle de *Placopyrenium bucekii* présente donc une structure relativement peu différenciée :

- La partie supérieure est formée de cellules anguleuses et à paroi mince, disposées en lignes verticales ; à l'intérieur de celle-ci, la couche algale ne se distingue du cortex (pseudocortex) que par la présence de cellules algales et l'absence de pigmentation.
- La partie inférieure est formée de cellules arrondies, à paroi nettement plus épaisse, ne présentant pas d'orientation privilégiée ; dans celle-ci, les cortex inférieur et latéral ne se distinguent de la médulle que par leur pigmentation brune et l'absence de méats.



Fig. 5. Coupe transversale d'une squamule fertile de *Placopyrenium bucekii* montée dans l'eau, montrant 3 périthèces

II — Ascomes (périthèces)

A. Morphologie

Les périthèces de *Placopyrenium bucekii* sont entièrement enfoncés dans le thalle et ne se remarquent à la surface des squamules que par le point noir de 0,1–0,3 mm formé par leur sommet. Généralement assez abondants sur les squamules centrales, ils sont absents sur les squamules périphériques. Le nombre de périthèces par squamule est très variable : certains thalles en sont totalement dépourvus, tandis que d'autres montrent jusqu'à 10 périthèces par squamule.

B. Structure (fig. 3b et fig 5 à 8)

Sur une coupe verticale passant par l'ostiole, les périthèces apparaissent ovoïdes et ont une hauteur de 100–250 µm et un diamètre de 100–200 µm. Le périthèce comporte, de l'extérieur vers l'intérieur :

- **Un involucrellum** (fig. 6–7) rudimentaire ou nul, qui ne se développe, facultativement, que chez les périthèces adultes et seulement au pourtour de l'ostiole. Il correspond à une simple modification (surtout pigmentation) des cellules thallines entourant l'excipulum.

- **Un excipulum**, incolore et de 20–30 µm d'épaisseur, qui s'élargit nettement (30–80 µm) au sommet du périthèce et devient en grande partie brun plus ou moins orangé ou rougeâtre. Entièrement paraplactenchymateux, il est formé de deux couches, qui ne sont bien distinctes que dans la moitié supérieure du périthèce :

- Couche externe (10–16 µm d'épaisseur, jusqu'à 25–30 µm au sommet), formée de cellules allongées ($3-13 \times 0,5-3 \mu\text{m}$), sauf dans la partie tout à fait superficielle du périthèce où elles sont souvent arrondies ($2,5-4,5 \times 1-3,5 \mu\text{m}$), à paroi relativement épaisse (0,5–2 µm), se pigmentant progressivement vers le sommet du périthèce (pigment sous forme de granules pigmentaires brun rougeâtre, bien visibles). Certains périthèces ont une pigmentation plus étendue vers le bas et leur moitié inférieure est alors brun pâle. Des cellules algales mortes semblent présentes dans la partie externe de cette couche, mais ce fait mériterait d'être confirmé.

- Couche interne (9–15 µm d'épaisseur, jusqu'à près de 60 µm au sommet), formée de cellules plus larges que celles de la couche externe ($6-9 \times 1,5-3,5 \mu\text{m}$), surtout dans la partie tout à fait supérieure où elles sont souvent arrondies ($3-9 \times 1-5 \mu\text{m}$).

- **Un subhyménium** (de 10–30 µm d'épaisseur), développé seulement dans la moitié inférieure du périthèce, incolore, formé par les cellules ascogènes et paraphysogènes.

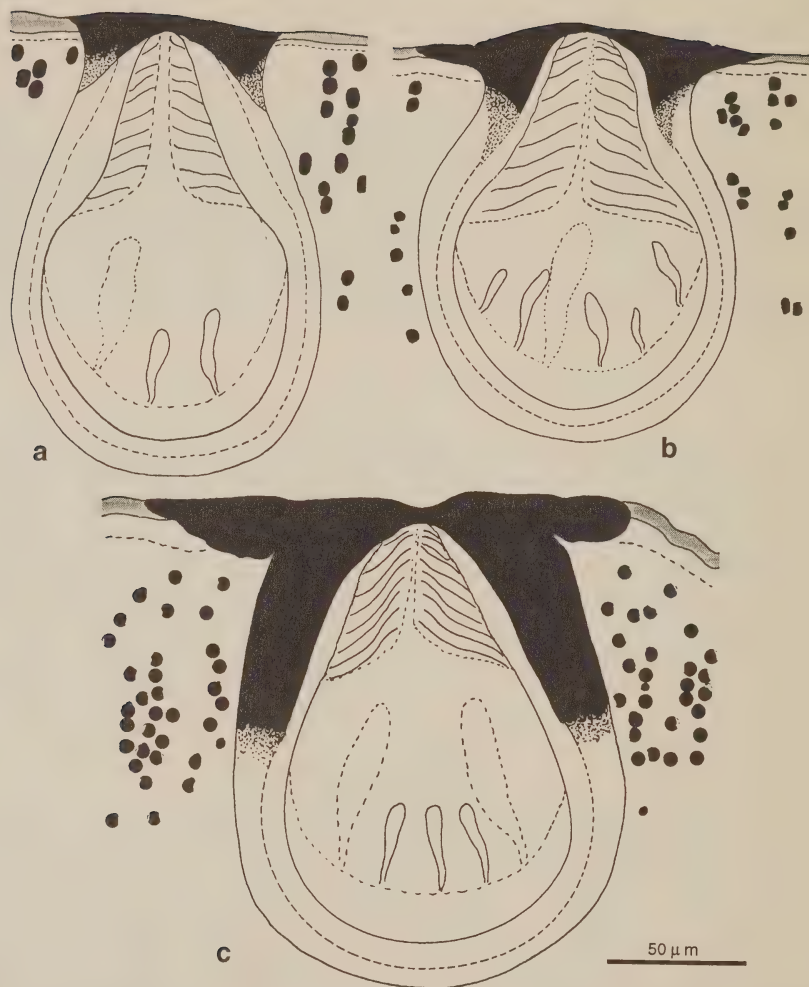


Fig. 6. Coupes transversales de trois périthèces (a, b et c) de *Placopyrenium bucekii* montées dans l'eau, montrant leur structure. De l'extérieur vers l'intérieur: involucrellum rudimentaire, pigmenté de brun sombre, au contact du cortex supérieur du thalle, absent chez a, inhabituellement développé chez c; excipulum, pigmenté de brun sombre seulement autour de l'ostiole chez a et b (cas de loin le plus fréquent), dans sa moitié supérieure chez c, formé de deux couches qui ne sont bien distinctes que dans la moitié supérieure du périthèce; subhyménium, limité à la moitié inférieure du périthèce; périphyses, à la partie supérieure; asques, à la partie inférieure.

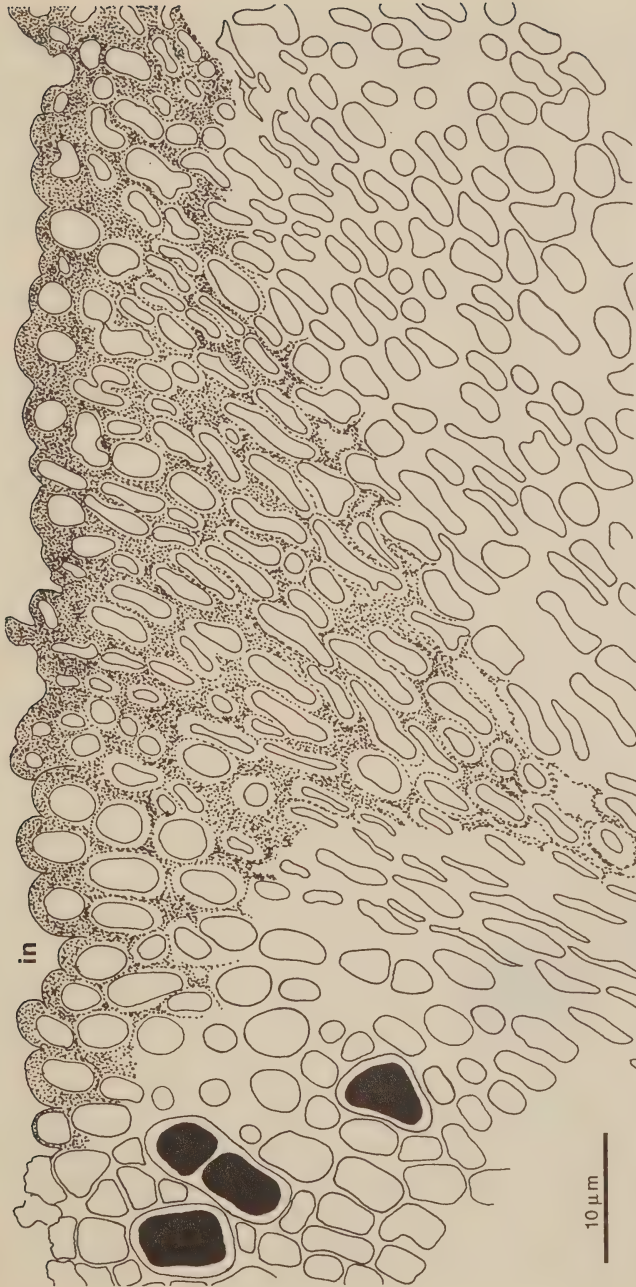


Fig. 7. Détail de la partie supérieure d'un périthèce de *Placopyrenium bucekii* montée dans le bleu au lactophénol. De l'extérieur (à gauche) vers l'intérieur (à droite) : thalle (cortex et couche algale) ; involucrellum (in) très réduit, pigmenté de brun sombre, à cellules larges, provenant de la modification de cellules thallines ; excipulum, partiellement pigmenté, à partie externe, formée de cellules allongées dont les supéro-externes sont pigmentées, et partie interne à cellules plus larges et même arrondies.

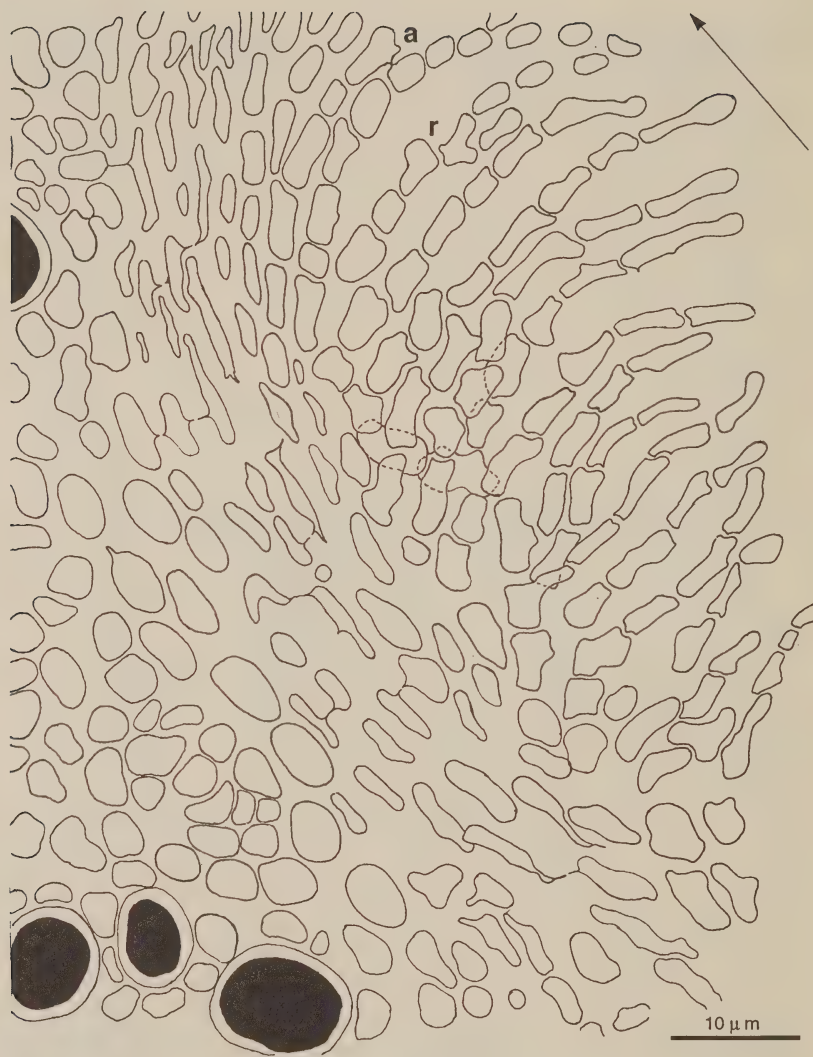


Fig. 8. Périphyces, d'après une coupe de périthèce, verticale, passant par l'ostiole, montée dans le bleu au lactophénol. De l'extérieur (à gauche) vers l'intérieur (à droite): couche algale du thalle (ronds noirs: cellules algales); excipulum externe (cellules allongées); excipulum interne (cellules moins allongées, plus rondes), générateur des périphyces, bien développées, parfois ramifiées (r), rarement anastomosées (a). La flèche indique l'axe vertical et le haut.

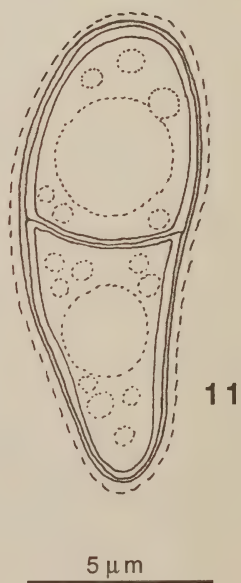
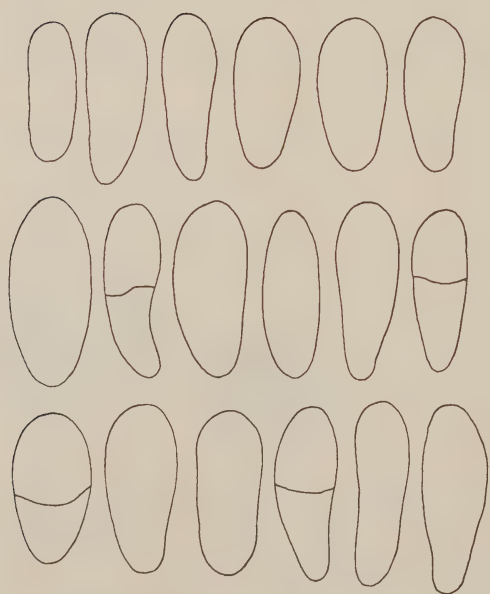
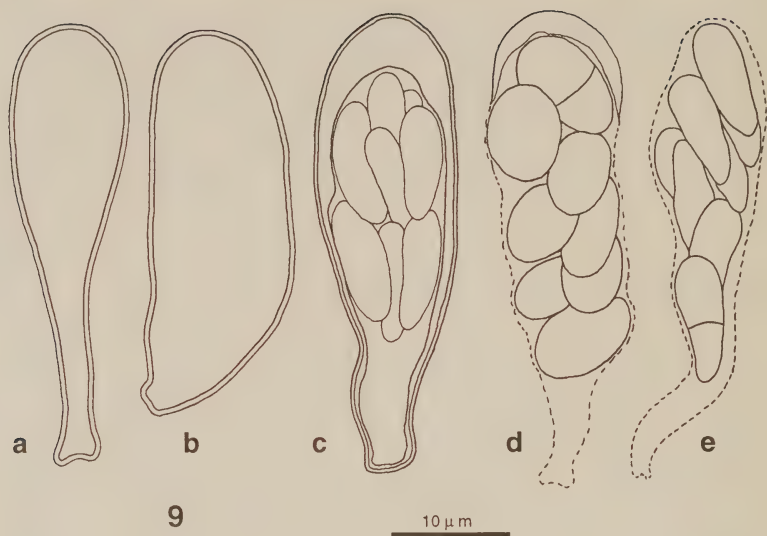
• **Un ostiole**, dont le canal, peu allongé mais bien distinct, est garni de périphyses ($30-40 \times 1-3 \mu\text{m}$) bien visibles (fig. 8), prenant naissance sur la face interne de l'excipulum, ascendantes (sur une coupe passant par l'ostiole), le plus souvent simples, parfois ramifiées, rarement anastomosées, la plupart formées de 5–7 cellules (de $3-11 \times 2-3,5 \mu\text{m}$).

• **Un hyménium**, contenant des asques et des paraphyses très fugaces qui se gélifient rapidement et sont donc difficiles à observer.

III — Asques et ascospores (fig. 9 à 11)

Les jeunes asques (fig. 9a et 9b), claviformes, ont une paroi uniformément mince, non épaissie au sommet. Cette paroi a tendance à se gélifier rapidement et même le plus souvent disparaître totalement avant l'apparition des spores. Rarement, nous avons cependant observé quelques asques typiquement bituniqués (fig. 9c), à endoascus épaissi en tholus au sommet, contenant des spores immatures ; d'autres asques, également rares, présentent des restes d'endoascus à leur partie supérieure (fig. 9d). En aucun cas nous n'avons observé de déhiscence du type *jack-in-the-box*. À maturité, les spores, par 8, sont réunies entre elles par l'épiplasma limité extérieurement par une mince membrane peu visible et fragile (fig. 9e). Il n'y a donc pas de déhiscence active mais libération des spores par gélification de la paroi de l'asque.

La plupart des spores mûres sont donc dispersées dans l'hyménium. Elles sont incolores, le plus souvent ellipsoïdales, subfusiformes ou ovoïdes, beaucoup plus rarement réniformes. Simples ou uniseptées (en proportions très diverses selon les périthèces), elles mesurent $(11,5)13,5-15,2-17(17,5) \times (4)5-5,8-7(7,5) \mu\text{m}$, avec un rapport longueur sur largeur de $(1,8)2,2-2,6-3,1(3,62)$ (d'après 42 mesures). Leur paroi comporte les éléments constitutifs suivants (nomenclature selon BELLEMÈRE 1994) : sous la limitante externe, une périspore externe, très mince ($\leq 0,5 \mu\text{m}$), BCr– ; une périspore interne, très mince, distincte de l'épispore (ou paroi propre) seulement après coloration par BCr (légèrement violacé) ou par BLF (bleuâtre sombre) ; une épispore BCr– et BLF– ; un espace périplasmique clair (pas d'endospore différenciée). La cloison, lorsqu'elle existe, est formée par l'épispore et la lame interoculaire et ne présente pas de torus apparent. Le cytoplasme contient généralement une ou deux grosses guttules et de petits globules souvent nombreux, qui ont tendance à disparaître en herbier.



IV — Conidiomes (pycnides) et conidies (fig. 12 à 15)

Les pycnides, entièrement enfoncées dans le thalle, ne sont décelables à la surface des squamules que par leur sommet formant un point noir de petite taille (inférieure à 0,1 mm).

Elles mesurent environ 70–120 µm de hauteur sur 75–160 µm de largeur. Leur structure, du type *Dermatocarpon* (JANEX et WAGNER 1986, ROUX et al. 1986), est formée d'une trame paraplectenchymateuse, constituée de une à cinq couches de cellules (2–5 × 1–3,5 µm) courtes, à paroi mince, délimitant d'assez nombreuses cavités bordées de cellules conidiogènes à collerette (phialides) incolores, en forme de bouteille courte (5,5–7 × 3,5–5 µm), produisant des conidies (microconidies) incolores, bacilliformes, simples, de (3)3,5–4,5–5,5(9) × 1–1,1–1,5 µm, dont le rapport longueur sur largeur est de (2,6)3,2–4,0–4,7(6,2) [d'après 30 mesures]. L'ensemble est entouré d'une enveloppe ou paroi pycnidiale (d'environ 6–7 µm d'épaisseur) peu distincte des faux tissus thallins environnants.

V — Réactions chimiques

Thalle (dans toutes ses parties) I–, K–, C–, KC–, P–. Périthèces I–, K–, C–, KC–, P–, sauf l'hyménium et le subhyménium I+ (bleu, dans le lugol, rougeâtre lorsque la concentration en iode est plus élevée).

Fig. 9. Asques observés dans l'eau. a et b) Jeunes asques, dépourvus de spores, à paroi mince. c) Asque assez jeune, avec spores immatures, typiquement bituniqué, à tholus bien développé (stade rarement observé). d) Asque un peu âgé, à paroi ayant en grande partie disparu par gélification : seule la partie supérieure de l'endoascus est encore visible au sommet de l'asque (stade rarement observé). e) Asque mûr à paroi ayant complètement disparu par gélification, réduit à l'épipleme contenant 8 spores.

Fig. 10. Diversité des spores (contenu et détails de la paroi non figurés).

Fig. 11. Détail de la structure d'une spore septée, colorée par le bleu de crésyl. De l'extérieur vers l'intérieur : limitante externe (pointillé), périspore externe blanc, périspore interne (grisé), épispore (= paroi propre), sporoplasme avec guttules (l'espace périplasmique et le plasmalemma ne sont pas représentés). Septum formé par l'épispore et la lame interloculaire, sans torus distinct.

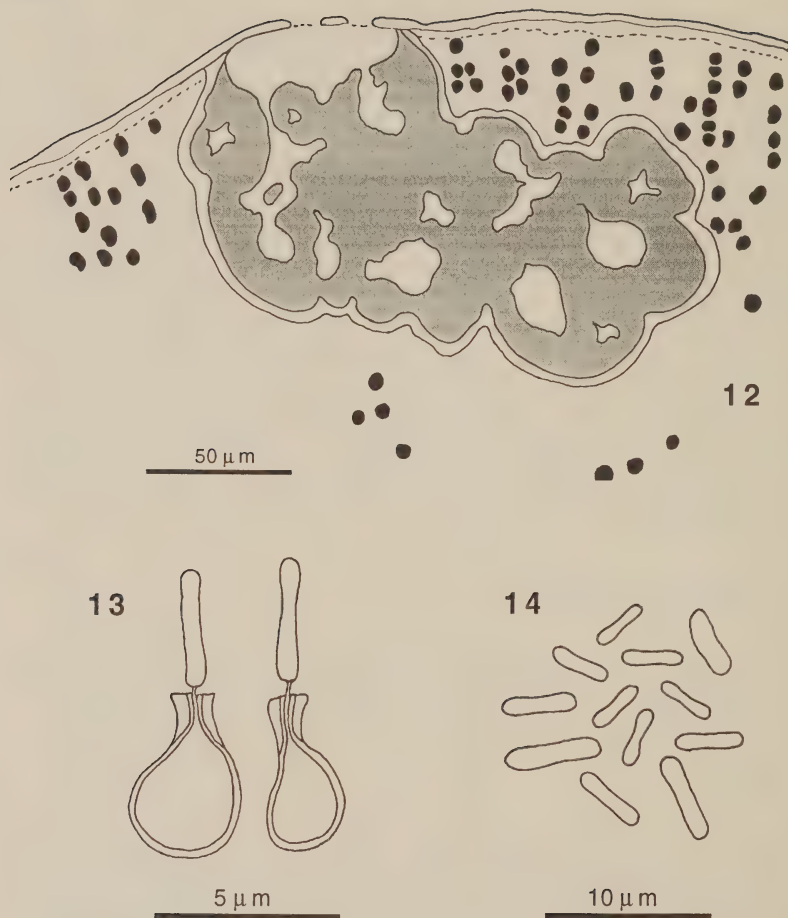


Fig. 12. Vue d'ensemble de la structure d'une pycnide particulièrement développée. De l'extérieur vers l'intérieur : ouverture, au sommet, par rupture du cortex du thalle (pas d'ostiole) ; enveloppe, entourant la totalité de la pycnide, mis à part le sommet ; partie fertile (en gris), constituée par une trame paraplectenchymateuse creusée de cavités tapissées de cellules conidiogènes (Chypre, Roux).

Fig. 13. Cellules conidiogènes à collerette et conidies.

Fig. 14. Conidies (microconidies).

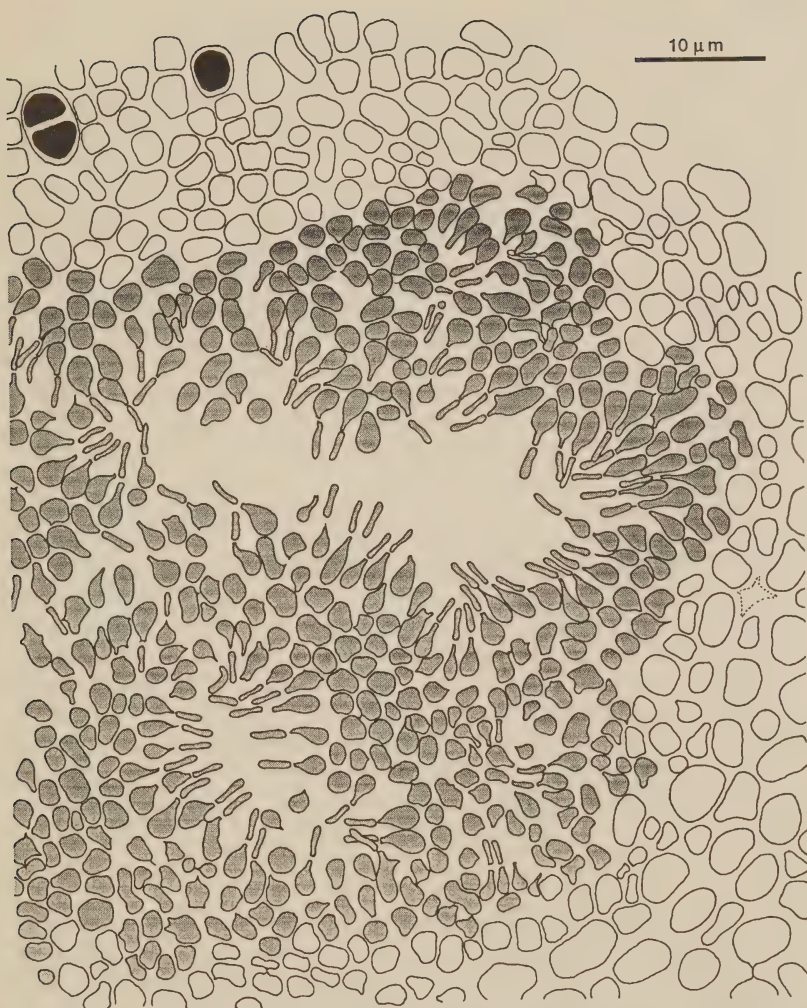


Fig. 15. Détail de la structure d'une partie de pycnide, d'après une coupe verticale montée dans le bleu au lactophénol. De haut en bas : couche algale du thalle, mince (ronds noirs : cellules algales) ; enveloppe pycnidiale, formée de cellules un peu plus petites que celle de la couche algale (située au-dessus) et de la médulle du thalle (située à droite et en-dessous) ; partie fertile (en gris), constituée par une trame paraplectenchymateuse (conidiophores) creusée de cavités tapissées de cellules conidiogènes produisant des conidies bacilliformes (Chypre, Roux).

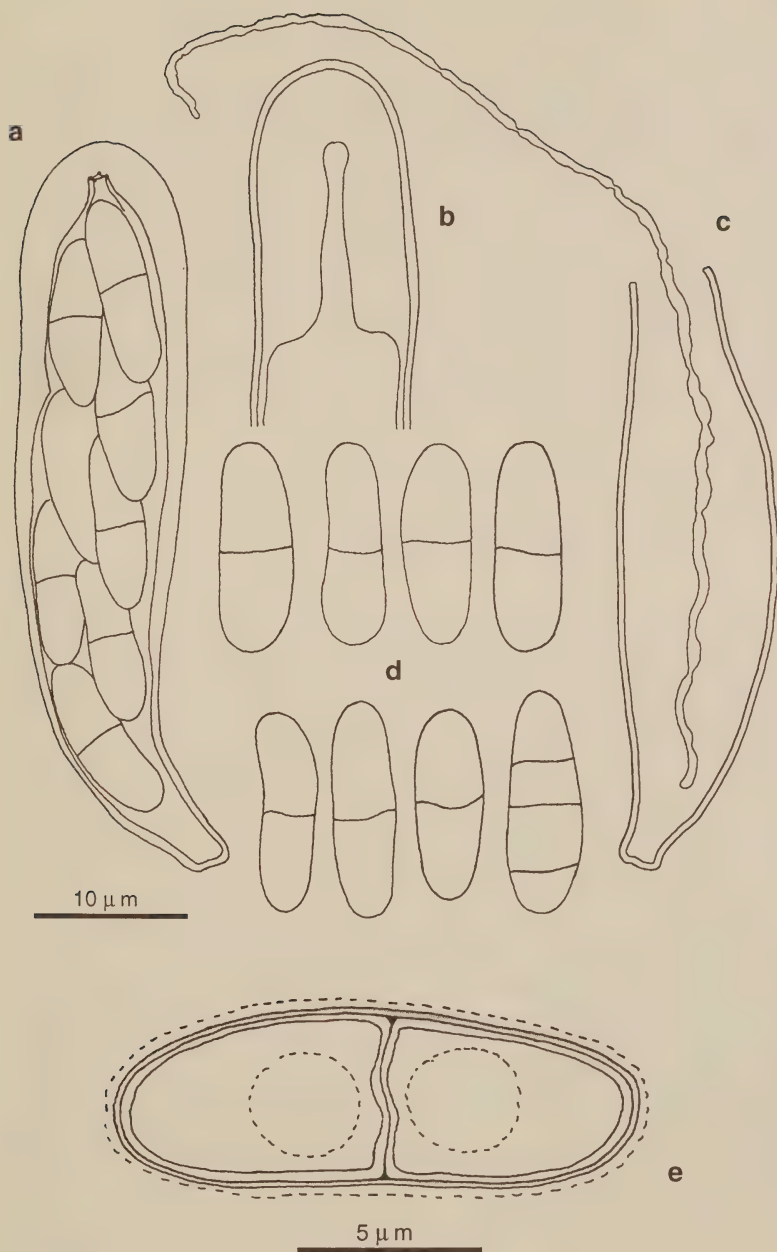
Affinités et remarques systématiques

A. Comparaison avec *Placopyrenium tatrense* et les *Placidiopsis*

Placopyrenium tatrense (Vězda) Breuß (BREUSS 1990b) est très proche de *Placopyrenium bucekii* par son thalle squamuleux, nettement lobé au pourtour, fixé au support par des crampons, et dont la structure est très semblable à celle de *Placopyrenium bucekii*, ainsi que par ses pycnides du type *Dermatocarpon*. Son thalle est cependant nettement plus réduit et ses squamules périphériques, relativement peu allongées, portent des périthèces. Mais surtout, *Placidiopsis tatrensis* a des asques (fig. 16) typiquement bituniqués, à paroi persistante, épaissie au sommet en un tholus creusé d'une chambre oculaire, fonctionnellement fissituniqués, à déhiscence du type *jack-in-the-box*. De plus, ils contiennent des spores qui ont régulièrement une (exceptionnellement 2 ou 3) cloisons à maturité.

Les *Placidiopsis* s. s., notamment *P. cinerascens* (Fr.) Breuß [= *P. tenella* auct. europ.] et *P. cartilaginea* (Nyl.) Vain. [= *P. custani* (Massal.) Körb.] ont un thalle squamuleux non lobé au pourtour, des hyphes médullaires nettement allongées, et sont dépourvus de crampons fixateurs (seulement des rhizohyphes chez *P. cinerascens* qui est dépourvu de cortex inférieur; pas d'organes fixateurs particuliers chez *P. cartilaginea* qui est muni d'un cortex inférieur noirâtre, d'épaisseur irrégulière, à cellules à paroi épaisse, la plupart subglobuleuses, les autres allongées. La structure des asques et des spores est semblable à celle de *Placopyrenium tatrense*. Les *Placidiopsis* semblent donc très proches des *Placopyrenium*; toutefois leurs conidiomes sont encore inconnus.

Fig. 16. *Placopyrenium tatrense*. a) Asque octosporé, à sommet épaissi en un tholus creusé d'une chambre oculaire contenant une nasse (coloration par le bleu de crésyl). b) Sommet d'un jeune asque après traitement par K: le tholus enfle notablement et la chambre oculaire devient très visible. c) Asque après déhiscence et dispersion des spores: stade relativement ancien, montrant l'exoascus (à la partie inférieure) et l'endoascus, très allongé et collapsé. d) Ascospores (contenu et détail de la paroi non représentés). e) Détail de la structure d'une spore colorée par le bleu de crésyl. De l'extérieur vers l'intérieur: périspore externe (limitée à l'extérieur par le pointillé), périspore interne, épispore, sporoplasme avec une guttule dans chaque cellule (l'espace périplasmique et le plasmalemma ne sont pas représentés). Septum formé par l'épispore et la lame interloculaire, sans torus distinct.



B. Comparaison avec *Verrucaria glaucina* et *V. lecideoides*

Par son thalle d'un gris assez clair, prumineux, à aréoles bordées de noir, ses cellules algales disposées en files verticales, *Placopyrenium bucekii* n'est pas non plus sans rappeler certains *Verrucaria*, plus particulièrement *V. lecideoides* et surtout *V. glaucina* auct. (= *V. nigricans* Nyl.). Cependant, le thalle de ces espèces est beaucoup plus réduit, crustacé, non lobé, dépourvu de pédoncules fixateurs, et leurs asques sont typiquement bituniqués (fissituniqués), à paroi persistante, épaisse au sommet en un tholus creusé d'une chambre oculaire, et à déhiscence du type *jack-in-the-box*. En outre, leurs périthèces deviennent entièrement noirs à la fin et leurs spores sont simples. Nous n'avons pas pu observer les conidiomes de ces deux *Verrucaria*, et ils ne semblent pas avoir été décrits dans la littérature.

C. Remarques sur les autres Verrucariaceae

1 – Structure et déhiscence des asques

Les autres Verrucariaceae d'Europe, plus éloignées de *Placopyrenium* par divers caractères, ont, à notre connaissance, des asques typiquement bituniqués, à paroi généralement épaisse (*Thelidium*, *Polyblastia*, *Staurothele*, *Catapyrenium*, *Dermatocarpon*, *Endocarpon*, *Placocarpus*), plus rarement mince (*Henrica*, voir NAVARRO-ROSINÉS et HLADUN 1992), ne se gélifiant pas à maturité, donc persistante, et, le plus souvent, leur tholus est plus ou moins développé.

La libération des spores par gélification de la paroi des asques semble cependant exister au moins chez certains *Verrucaria* aquatiques, comme nous avons pu l'observer chez *V. elaeomelaena* s. s. et chez *V. hydrela*, où la paroi de l'asque persiste cependant beaucoup plus longtemps que chez *P. bucekii*. Par ailleurs, PURVIS et al. (1993) indiquent que ce type de libération des spores existe chez certains *Verrucaria*, mais ne précisent pas chez quelles espèces elle se produit.

Placopyrenium bucekii semble donc différer d'au moins une grande partie des Verrucariaceae par la gélification très précoce de la paroi de ses asques, mais ce caractère ne résulte peut-être que d'une adaptation au mode de vie aquatique, puisque *Placopyrenium tatrense*, non aquatique, très proche de *P. bucekii* par de nombreux caractères, a des asques dont la structure et la déhiscence sont du type de celles de la majorité des Verrucariaceae.

2 – Structure et ontogénie des conidiomes (pycnides)

La structure et l'ontogénie des pycnides sont certainement importantes pour la systématique des Verrucariaceae, mais elles restent encore insuffisamment connues. Dans cette famille, on peut actuellement distinguer au moins trois types de pycnides (HARADA 1992–1993, JANEX et WAGNER 1986, MACCARTHY 1991, ROUX et al. 1986):

- Le type *Dermatocarpon* (= type “*Endocarpon*” de GLÜCK), où les pycnides ont plusieurs cavités qui se forment tardivement et restent séparées par une trame paraplectenchymateuse, cavités qui ne produisent pas de filaments radiaires mais dont les cellules bordantes deviennent conidiogènes (type endobasidié de Steiner 1901). Ce type de pycnides est placé dans le type *Xanthoria* par certains auteurs (BREUß 1990a, HARADA 1993a, VOBIS 1980, VOBIS et HAWKSWORTH 1981), mais nous préférons suivre l'opinion de JANEX et WAGNER (1986: 180) et, au moins pour l'instant, ne pas adopter ce terme chez les Verrucariaceae. Le type *Dermatocarpon* a été signalé chez les genres *Dermatocarpon* (GLÜCK 1889, HARADA 1993a, JANEX et WAGNER 1986, ROUX et al. 1986), *Dermatocarpella* (HARADA 1993), *Heterocarpon* (HARADA 1991), *Catapyrenium* sensu Breuß (GLÜCK 1889, BREUß 1990a) et *Placocarpus* (Harada 1993a: 123).

En réalité, le type *Dermatocarpon* doit être assez répandu chez les Verrucariaceae, puisque nous l'avons observé non seulement chez *Placopyrenium bucekii*, les *Catapyrenium* sensu Breuß et *Placocarpus schaeferi*, mais aussi (observations non publiées) chez *Placopyrenium tatrense* et deux *Verrucaria* du groupe *helveticorum* (*Verrucaria helveticorum* et *V. irrubescentis* Ménard et Roux). Le nombre de locules varie considérablement selon les genres: il est maximal chez les *Dermatocarpon* (à pycnides relativement grandes) et minimal chez les *Verrucaria* du groupe *helveticorum* (à pycnides de petite taille), où l'on n'observe que 2 à 5 cavités sur une coupe.

- Le type *Endocarpon* (sensu JANEX et WAGNER 1986, non GLÜCK), à paroi rudimentaire et à contour sinueux, où les pycnides ont une cavité unique, se formant précocement et garnie de filaments conidiogènes radiaires portant les cellules conidiogènes. La conidiogénèse est également du type endobasidié, puisque plusieurs cellules d'un même filament, et non seulement sa seule cellule apicale, donnent naissance aux conidies. Ce type n'a jusqu'ici été signalé que chez *Endocarpon pusillum*, où l'ontogénie des pycnides n'a pu être étudiée comme chez les *Dermatocarpon* faute de matériel convenable.

Récemment, HARADA (1992a–b, 1993) a introduit chez les Verrucariaceae, le type *Staurothele* (défini d'après l'espèce *Staurothele iwatsukii* Harada) où les pycnides sont caractérisées par “une cavité simple, rare-

ment lobée [semi-plural selon son expression en anglais], entourée d'hyphes plus ou moins allongées". Il assimile ce type au type *Endocarpon* de WAGNER et JANEX (1986), sans préciser pourquoi il ne conserve pas le nom *Endocarpon* pourtant prioritaire.

La description du type *Staurothele* est à notre avis insuffisante, puisqu'elle est réduite à la phrase citée ci-dessus et illustrée par des microphotographies peu claires et des dessins de petite taille qui semblent montrer une certaine hétérogénéité de structure. D'après les figures de HARADA (loc. cit.), on peut d'ailleurs se demander si le type *Staurothele* est vraiment identique au type *Endocarpon*:

– Chez *Endocarpon japonicum*, *E. ramulosum* (HARADA 1993b: 339, fig. K; 350, fig. K) et *Neocatapyrenium cladonioideum* (HARADA 1993a: 130, fig. J), c'est vraisemblable puisque la conidiogenèse semble bien du type endobasidié.

– Au contraire, chez *Verrucaria napponica* (HARADA 1992b), *Endocarpon neopallidum* et *E. nigromarginatum* (HARADA 1993b: 341, fig. J; 343, fig. H), *Scleropyrenium japonicum* et *S. kurokawae* (HARADA 1993a: 134, fig. H; 136 fig. H), la conidiogenèse paraît du type exobasidié puisque les conidies sont toutes situées à l'apex de cellules conidiogènes allongées.

– Enfin, chez d'autres espèces, il est difficile de se prononcer sur le caractère endo- ou exo-basidié de la conidiogenèse. C'est le cas d'*Endocarpon petrolepideum* et d'*E. superpositum* (HARADA 1993b: 345, fig. K et 352, fig. H–J), plutôt de type endobasidié, et de *Staurothele iwatsukii* (HARADA 1992a: 41, fig. G) plutôt de type exobasidié.

Il se pourrait donc que le type *Staurothele* ne soit pas identique au type *Endocarpon*. Toutefois, il faut se garder d'interprétations hâtives basées sur les seules figures de HARADA. En effet, celle relative à *Endocarpon pusillum* (HARADA 1993b: 348, fig. B) montre une conidiogenèse du type exobasidié, en contradiction avec l'interprétation de JANEX et de WAGNER (1986).

La question du type conidien chez les *Staurothele* et *Endocarpon* reste à notre avis non résolue en l'absence d'étude suffisante de leur structure et surtout de leur ontogénie, d'autant plus que le cas des *Verrucaria* du groupe *helveticorum*, où les pycnides sont formées de quelques locules seulement, autorise à envisager l'existence de pycnides du type *Dermatocarpon* uni- ou bi-loculaires.

• Enfin, il existe un troisième type de pycnide chez *Verrucaria subdiscreta* MacCarthy (1991: 328), constitué par une seule locule à ostiole particulièrement net, recouverte dans sa moitié supérieure d'une sorte d'involucrellum épais et carbonacé, qui manque totalement chez les types précédents. La figure de l'auteur, trop petite, ne permet pas de se prononcer sur le type de conidiogenèse, endo- ou exo-basidié.

Le genre *Verrucaria*, type de la famille des Verrucariaceae, apparaît donc hétérogène en ce qui concerne la structure des pycnides qui semblent d'ailleurs inconnues chez l'espèce type, *Verrucaria rupestris* (= *V. muralis*).

En conclusion, les connaissances relatives à la structure et surtout à l'ontogénie des pycnides des Verrucariaceae étant encore insuffisantes, il serait prématuré de formuler des conséquences systématiques à l'existence des types de pycnides.

Répartition géographique

SERVÍT (1936) mentionne *Placopyrenium bucekii* en Bulgarie, en Hongrie, dans le Caucase et en Corse. BREUSS (in NIMIS et POELT 1987) signale cette espèce en Sardaigne et indique qu'elle présente une répartition principalement méditerranéenne et subméditerranéenne, du Caucase aux Canaries.

Nous l'avons trouvée non seulement en France (Provence et Corse : voir section Écologie et section Spécimens examinés), mais également en Grèce (Péloponnèse) et à Chypre, où elle ne semble pas avoir été signalée (voir section Spécimens examinés). L'un de nous (C. R.) l'a également observée en Sardaigne, avec P. NIMIS, M. TETRIACH et A. VĚZDA.

Écologie

Dans la station de Provence, sur la montagne de Roquebrune, de loin la mieux étudiée d'un point de vue floristico-écologique, *Placopyrenium bucekii* s'établit sur des microbrèches granitiques et rhyolitiques à ciment non calcaire, soumises à des écoulements temporaires, à l'étage mésoméditerranéen (RIVAS-MARTINEZ 1981). Il est associé notamment à *Dermatocarpon luridum* (forme pruneuse), *Staurothele fissa* (incl. *S. hazslinszkyi*), *Verrucaria aethiobola*, *Verrucaria marga- cea* etc. (voir BRICAUD et al. 1992).

Sur la montagne de Roquebrune, les surfaces rocheuses soumises à des écoulements, nombreuses et variées, permettent le développement de 3 groupements liés à la durée plus ou moins prolongée après les pluies de ces écoulements, selon un gradient écologique d'humidité croissante. De ce point de vue, le groupement à *Placopyrenium bucekii* se situe entre le *Peltuletum euplocae* V. Wirth 1972 (EGEA et LLIMONA

1983 ; MÉNARD et ROUX 1991), soumis à des écoulements peu prolongés après les pluies, et l'*Ephebetum lanatae* Frey 1922, soumis à des écoulements particulièrement prolongés après les pluies. À l'intérieur même du groupement à *Placopyrenium bucekii*, on peut distinguer plusieurs faciès liés au gradient d'humidité. Par exemple, dans les parties les plus humides, *Dermatocarpon luridum* domine largement *P. bucekii*, tandis qu'apparaît *Ephebe lanata*, transgressive de l'*Ephebetum lanatae*. Sur le bord, moins longtemps mouillé, des surfaces de ruissellement, *Lecanora vaenskaei* Roux et Coste (Roux et al. 1993) devient abondant et parfois même dominant.

Dans les autres stations que nous avons observées, *P. bucekii* se rencontre également dans l'étage mésoméditerranéen. En Corse, en Sardaigne et à Chypre, son écologie est très proche de celle qu'il a en Provence, mais il s'établit sur des roches beaucoup plus cohérentes (rhyolite et dolérite). Il est alors associé à *Dermatocarpon luridum* et parfois à *Aspicilia polychroma* (Chypre) ou à *Peltula euploca* (Corse). Au contraire, en Grèce, dans le Péloponnèse (près de Sparti), *P. bucekii* se rencontre sur roche nettement calcaire soumise à des écoulements temporaires ; il est alors associé à des espèces bien différentes, calcicoles, notamment *Collema cristatum*, *Dermatocarpon miniatum*, *Placolecis opaca*, *Solenopsora candicans*, *S. cesatii*, *Verrucaria nigrescens*.

Dans l'ensemble, *P. bucekii* apparaît donc comme une espèce saxicole (sur roches modérément ou fortement cohérentes) surtout calcifuge, mais pouvant néanmoins s'établir parfois sur des roches franchement calcaires. Dans les deux cas, elle ne se rencontre que sur les surfaces soumises à des écoulements prolongés après les pluies, et, du point de l'hydrophilie, se situe entre le *Peltuletum euplocae* (moins hydrophile) et l'*Ephebetum lanatae* (plus hydrophile).

Spécimens examinés

Les dates sont indiquées selon le système international an/mois/jour. Les localités des spécimens cités sont conformes aux indications qui figurent sur l'étiquette des spécimens d'herbiers, mis à part les noms du pays et de la province qui sont mentionnées en français.

***Placidiopsis cartilaginea* (Nyl.) Vain. (= *P. custani*)**

France, Provence, Vaucluse, Lioux, la Jaille (apud Javon), sur kalka-argila grundo super kalka roko tre kohera kaj kompakta, mal-multe fenda. Alt. 760 m. 1989/05/03. G. CLAUZADE, O. BRICAUD et C. ROUX, herb. C. ROUX, MARSSJ n° 20519 (vérif. O. BREUSS).

***Placidiopsis cinerascens* (Nyl.) Breuß.**

France, Provence

- Bouches-du-Rhône, Martigues, valetto Bonnieux, sur argila grundo senkalkigita, tonsuraĵo en *Staticetum echioidis*. Alt. 20 m. 1970/11/28. G. CLAUZADE et C. ROUX, herb. C. ROUX, MARSSJ n° 20730 (dét. O. BREUSS).

- Bouches-du-Rhône, Marseille, plataĵo la Mûre, Payan, sur pado, sur kalka-argila grundo piedtreta. Alt. 220 m. 1993/11/09. C. ROUX, herb. C. ROUX, MARSSJ n° 21679.

- Vaucluse, Apt, bieno Murs, apud rivero Calavon (= Coulon), kriptogama tonsuraĵo sur kalka grundo, super kalrokoj aptaj-urgoniaj, en maldensejo de *Quercus pubescens*. Alt. 220 m. 1965/04/23. J. LAMBINON, herb. G. CLAUZADE, MARSSJ n° 3 (dét. O. BREUSS).

Italie, Sardaigne, Cagliari, vilao Alcais, sur argila grundo. 1990/06/02. CANEVA, herb. B. DE LESD. (ex SBARBARO, sub. *Placidiopsis circinata* n° 614), MARSSJ n° 2 (dét. O. BREUSS).

***Placocarpus schaereri* (Fr.) Breuß**

France, Provence, Vaucluse, Apt, environs d'Apt, sur rocher de molasse burdigalienne. Sans date. G. CLAUZADE, herb. B. DE LESD., MARSSJ n° 61.

Placopyrenium bucekii

Chypre, Prov. Nicosie, Alona, apud la vojo, nedaŭra akvofalo (loko n° 33), sur krutaĵo el nekalka petro (dolerito?) tre kohera kaj kompakta aŭ lokloke fajne grajna, fenda. Alt. 940 m. 1991/04/26. C. ROUX, herb. C. ROUX, MARSSJ n° 21674 à 21677 (vérif. O. BREUSS).

France

• Haute-Corse, Galeria, N de Galeria, baze de punta di Ciuttone, apud la maro, sur nekalka petro tre kohera k kompakta, elmetita al nedaŭraj elfluetoj. Alt. 160 m. 1985/08/05. C. Roux, herb. C. Roux, MARSSJ n° 21095.

• Var, Roquebrune-sur-Argens, montagne de Roquebrune, E-parto, supre, sur krutaĵo el breĉio kun granitaj eroj. Alt. 200 m. 1991/05/21. T. MÉNARD et C. ROUX, herb. C. Roux, MARSSJ n° 21092 (vérif. O. BREUSS).

• Ibid., herb. T. MÉNARD (plusieurs spécimens).

Grèce, Péloponnèse, Mistra, bizanca kastelaro de Mistra, apud Sparti, sur krutaĵo el kalka petro tre kohera, kristala. Alt. 600 m. 1989/09/20. C. Roux, herb. C. Roux, MARSSJ n° 21673 (vérif. O. BREUSS).

Placopyrenium tatrense* (Vězda) Breuß*France, Pays-Basque**

• Pyrénées-Atlantiques, Larrau, alta baseno de Soule, gave Holzarté, apud Cayolar de Phista, sur granda kalka roko. Alt. 1350 m. 1972/10/26. J. VIVANT, herb. G. CLAUZADE, MARSSJ n° 1.

• Ibid., herbier C. ROUX, MARSSJ n° 20731.

Tchécoslovaquie, Tatras, monto Belanské Tatry, supraparte de valo Holybyho dolina, sur kvarcito. Alt. 1500 m. A. VĚZDA, herb. C. Roux (ex herb. A. VĚZDA), MARSSJ n° 21678 (partie de l'holotype).

***Verrucaria elaeomelaena* s. s.**

Espagne, Pays Basque, Soba, Naciente del río Asón, sur rokoj el kompakta k tre kohera kalkopetro. Alt. 600 m. 1990/11/01. G. RENOBALLES, herb. C. Roux, MARSSJ n° 20764.

Verrucaria glaucina* auct. (= *V. nigricans* Nyl.)*France, Languedoc**

• Gard, Villeneuve-lès-Avignon, piede de la krutaĵo Grand-Montagner, surgrunda bloketo (baremia) el kalka petro iom argila sed tre kohera, kompakta. Alt. 60 m. 1976/07/29. C. Roux, herb. C. Roux, MARSSJ n° 21680.

• Gard, Roquemaure, monto de Saint-Géniès, la Parra, sur krutaĵo (falto de Roquemaure) el urgonia kalko (baremia). Alt. 35 m. 1965/10/01. C. ROUX, herb. C. ROUX, MARSSJ n° 21681.

Verrucaria hydrela

France, Provence, Var, Nans-les-Pins, montaro Sainte-Baume, valeto Castelette, 100 m super la fonto, en la torenteto, sur kalka petro tre kohera k kompakta. Alt. 580 m. 1990/06/02. O. BRICAUD et C. ROUX, herb. C. ROUX, MARSSJ n° 20723 et n° 20717.

France, Poitou-Charentes, Deux-Sèvres, Secondigny, en rivereto, sur ŝtonoj el nekalka magmopetro, ombraj, inundataj escepte dum somero. 1976/12/27. J.-M. HOUMEAU, herb. C. ROUX, MARSSJ n° 21682.

Verrucaria lecideoides

France, Languedoc, Hérault, Laurens, apud la stacidomo, supre de kalka-grejsa roko (devonia), ombrita de *Quercus coccifera*. Alt. 150 m. 1964/06/22. G. CLAUZADE, herb. G. CLAUZADE, MARSSJ n° 60

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LE GENRE *WEDDELLOMYCES* (DOTHIDEALES, DACAMPIACEAE) EN CATALOGNE ET EN PROVENCE

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Résumé: Étude des taxons du genre *Weddellomyces* D. Hawksw. de Catalogne (NE de l'Espagne) et de Provence (SE de la France). *Weddellomyces epicallopusma* est mentionné pour la première fois dans ces deux régions et *W. macrosporus* pour la première fois en Catalogne. Description de trois nouvelles espèces: *Weddellomyces erythrocarpae* parasite de *Caloplaca erythrocarpa*; *W. heterochrous* et *W. pachyosporicola* parasites d'*Aspicilia* gr. *calcareae*. Discussion sur la définition du genre *Weddellomyces* et sur sa distinction des autres genres lichénicoles de la famille des *Dacampiaceae* et du genre *Leptosphaeria*.

Resumen: Estudio de los táxones del género *Weddellomyces* D. Hawksw. en Cataluña (NE de España) y en Provenza (SE de Francia). *Weddellomyces epicallopusma* es mencionado por primera vez en ambas regiones, y *W. macrosporus* es primera cita para Cataluña. Tres nuevas especies son propuestas: *Weddellomyces erythrocarpae*, parásito de *Caloplaca erythrocarpa*; *W. heterochrous* y *W. pachyosporicola*, parásitos de *Aspicilia* gr. *calcareae*. Se comenta la delimitación del género *Weddellomyces* y su diferenciación de los otros géneros liquenícolas de la familia *Dacampiaceae* y del género *Leptosphaeria*.

Resumo : Studo de la taksonoj de la genro *Weddellomyces* D. Hawksw. en Katalunio (NE de Hispanio) kaj en Provenco (SE de Francio). *Weddellomyces epicallopisma* estas nove trovita en ambaŭ regionoj kaj *W. macrosporus* en Katalunio. Priskribo de tri novaj specioj : *Weddellomyces erythrocarpae*, parazita al *Caloplaca erythrocarpa*; *W. heterochrous* kaj *W. pachyosporicola* parazitaj al *Aspicilia* gr. *calcareae*. Diskuto pri la difino de la genro *Weddellomyces* kaj pri ties distingo de la aliaj likenloĝaj genroj de la familio *Dacampiaceae* kaj de la genro *Leptosphaeria*.

Abstract : Study of the taxa of the genus *Weddellomyces* D. Hawksw. in Catalonia (NE Spain) and Provence (SE France). *Weddellomyces epicallopisma* is reported from the regions mentioned for the first time, and *W. macrosporus* is new for Catalonia. Three new species are described: *Weddellomyces erythrocarpae*, parasitic on *Caloplaca erythrocarpa*; *W. heterochrous* and *W. pachyosporicola* parasitic on *Aspicilia* gr. *calcareae*. The delimitation of the genus *Weddellomyces* and its differentiation from the other genera which include lichenicolous species of the family *Dacampiaceae* and from the genus *Leptosphaeria* are discussed.

Introduction

HAWKSWORTH (1986) a décrit le genre *Weddellomyces* (Dothideales Lindau 1897; *Dacampiaceae* Körber 1855) sur la base d'une seule espèce, *W. epicallopisma* (Weddell) D. Hawksw. Dans cette publication, le genre est défini par ses ascomes périthécioïdes, noirs, subglobuleux, à région ostiolaire s'ouvrant par des fissures irrégulières, à excipulum pseudoparenchymateux (= paraplectenchymateux), présentant dans sa partie supérieure, selon l'expression de l'auteur, des plaques céphalothécioïdes, par son hamathécium formé de filaments interascaux ramifiés-anastomosés, non ascendants (pseudoparaphyses au sens des auteurs anglo-saxons), par ses asques subcylindriques ou clavi-formes-allongés, bituniqués, octosporés, et par ses spores ellipsoïdales, (1)3-septées, d'un brun doré, à surface verruqueuse.

Ultérieurement, ALSTRUP et HAWKSWORTH (1990) ont considérablement élargi le concept du genre *Weddellomyces* en y incluant trois espèces dépourvues de plaques céphalothécioïdes et à spores parfois submurales: *W. geographicola* (Arnold) Alstrup et D. Hawksw, *W. periphericus* (Taylor) Alstrup et D. Hawksw. (sub *W. peripherica*) et *W. tartaricola* (Lindsay) Alstrup et D. Hawksw.

Deux autres espèces ont été récemment décrites, *W. macrosporus* D. Hawksw. Renobales et Coppins (HAWKSWORTH 1990, sub *W. macrospora*) et *W. aspiciliicola* Alstrup (ALSTRUP 1992), qui présentent les caractéristiques essentielles du genre, en particulier la partie supérieure de la paroi de leurs ascomes munie de plaques céphalothécioïdes.

Toutes les espèces traitées dans le présent travail ont des ascomes présentant la structure typique du genre et des spores cloisonnées transversalement, non submurales, sauf rares exceptions. La plupart ont déjà fait l'objet d'une description provisoire par l'un de nous (NAVARRO-ROSINÉS 1992).

Matériel et méthodes

Les échantillons étudiés ont été récoltés par les auteurs dans diverses localités de Catalogne (NE de l'Espagne) et de Provence (SE de la France). Les coupes microscopiques ont été réalisées à main levée et observées dans l'eau, le bleu de crésyl (BCr), le lugol (I) ou dans le bleu de lactophénol, avec un microscope optique (grandissement maximal de $\times 1500$). Les mesures ont toutes été effectuées dans l'eau. Les dessins ont tous été réalisés avec l'aide d'un tube à dessin.

Pour chaque spécimen, nous avons mesuré au moins 30 spores. Dans l'expression de leurs dimensions, la moyenne est indiquée en italique, encadrée par les valeurs extrêmes après élimination des 10% des valeurs les plus élevées et des 10% des valeurs les plus faibles, tandis que les valeurs extrêmes absolues sont placées entre parenthèses.

La nomenclature adoptée est, à quelques rares exceptions près, celle des ouvrages suivants :

- pour les champignons lichénicoles non lichénisés, la flore de CLAUZADE, DIEDERICH et ROUX (1989).
- pour les lichens, la flore de CLAUZADE et ROUX (1985) et ses suppléments (CLAUZADE et ROUX 1987, 1989).

Caractères généraux du genre *Weddellomyces*

***Weddellomyces* D. Hawksw.**

Notes RBG Edinb. **43**(3): 511 (1986).

Espèce type: *Weddellomyces epicallospisma* (Weddell) D. Hawksw. ($\equiv$ *Verrucaria epicallospisma* Weddel).

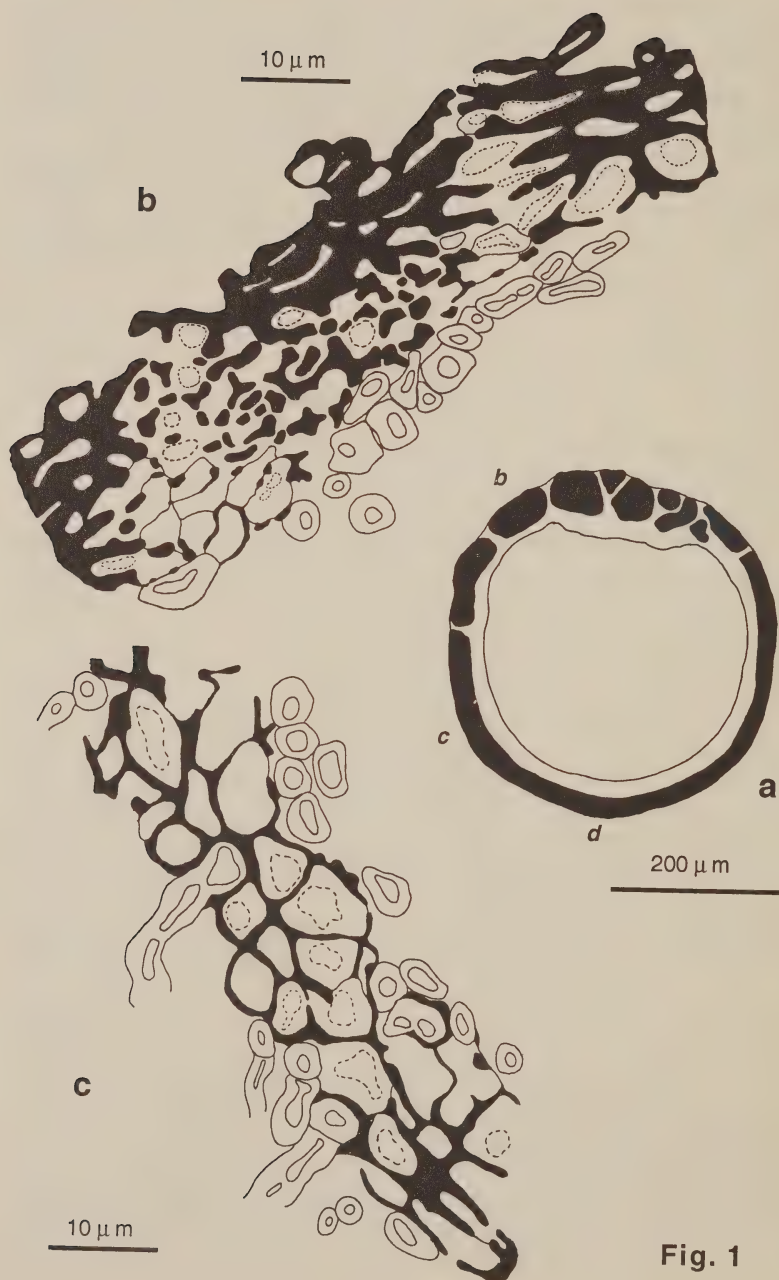


Fig. 1

Mycélium formé d'hyphes issues de la base des ascomes (fig. 1c), incolores, de 2–4,5 μm de diamètre, à cellules courtes et à paroi épaisse (1–2 μm).

Ascomes périthécioïdes, globuleux, de 0,2–0,4(0,5) mm de diamètre, d'abord complètement enfoncés dans le thalle de l'hôte, puis érupants, à surface un peu rugueuse et à ostiole légèrement déprimé, à ouverture irrégulière, en forme de fissures radiales.

Excipulum (fig. 1) constitué de deux couches de faux tissus :

- L'externe (20–30 μm d'épaisseur à la base, jusqu'à 50 μm au sommet), formée de 3 à 5 couches de cellules très diverses, à paroi brun sombre, pseudoparenchymateuse, munie, principalement dans la moitié supérieure, de plaques céphalothécioïdes. Ces plaques (HAWKSWORTH, 1986) sont constituées par des groupes de cellules allongées, polyédriques, à paroi plus épaissie et plus sombre, disposées radialement en groupes quadrangulaires ou pentagonaux, séparés par des bandes de cellules à paroi mince et claire (fig. 1b).

- L'interne (5–7 μm d'épaisseur), formée d'une, plus rarement de deux couches de cellules incolores, arrondies ou un peu allongées (3–6 $\times$ 3–5 μm), à paroi épaisse (0,5–2 μm).

Hamathécium (fig. 2) formé de filaments interascaux non ascendants (paraphysoïdes? voir remarque ci-après), d'épaisseur variable, de 2–4 μm sur le matériel vivant, de seulement 1–2 μm sur le matériel d'herbier, ramifiées–anastomosées (fortement dans la partie supérieure de l'ascome). Périphyses s. l. absentes.

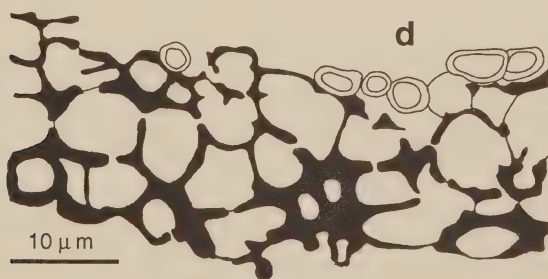


Fig. 1 — *Weddellomyces epicallospisma*. Structure de la paroi du périthèce (excipulum). a) Ensemble du périthèce (section verticale); b) détail de la partie supérieure montrant une plaque céphalothécioïde (sombre) et deux interplaques (claires); c) détail de la partie inférieure (montrant également la base des hyphes végétatives); d) détail de la partie basale.

Remarque: Le terme de pseudoparaphyses est utilisé par les auteurs anglo-saxons pour désigner les filaments interascaux non ascendants des ascoms périthécioïdes. Par contre, pour les auteurs français de l'école de CHADEFAUD (BELLEMÈRE 1968; JANEX-FAVRE 1971; LETROUT-GALINOU 1961, 1966, 1967; LETROUT-GALINOU et BELLEMÈRE 1989; PARGUEY-LEDUC 1966) et pour ERIKSSON (1993: 308), il désigne uniquement des filaments descendants, depuis la cloche sushyméniale, qui peuvent éventuellement se fixer au sous-hyménium. Ces derniers auteurs réservent le nom de paraphysoïdes aux filaments interascaux qui, au moins au début, sont rattachés à la cloche sushyméniale et au sous-hyménium. Chez les *Weddellomyces*, les auteurs (voir Introduction) ont jusqu'ici utilisé le terme de pseudoparaphyses bien qu'ils n'aient donné aucune précision sur l'ontogénie de l'hamathécium. Nous mêmes n'avons pas réussi à observer dans de bonnes conditions

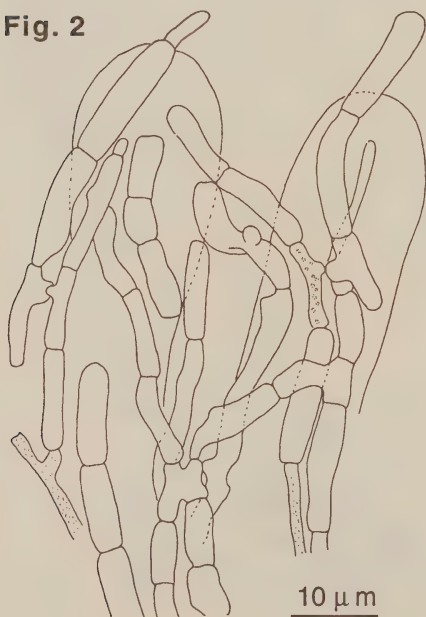
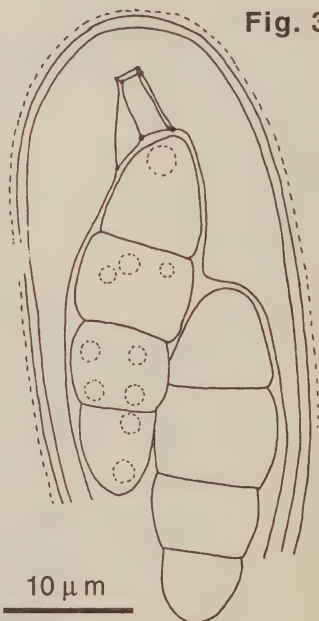
Fig. 2**Fig. 3**

Fig. 2 — *Weddellomyces epicallopisma*. Structure de l'hyménium montrant les filaments interascaux (matériel frais observé dans l'eau).

Fig. 3 — *Weddellomyces epicallopisma*. Structure du sommet d'un asque montrant la chambre oculaire et la nasse apicale (matériel frais coloré par le bleu de crésyl).

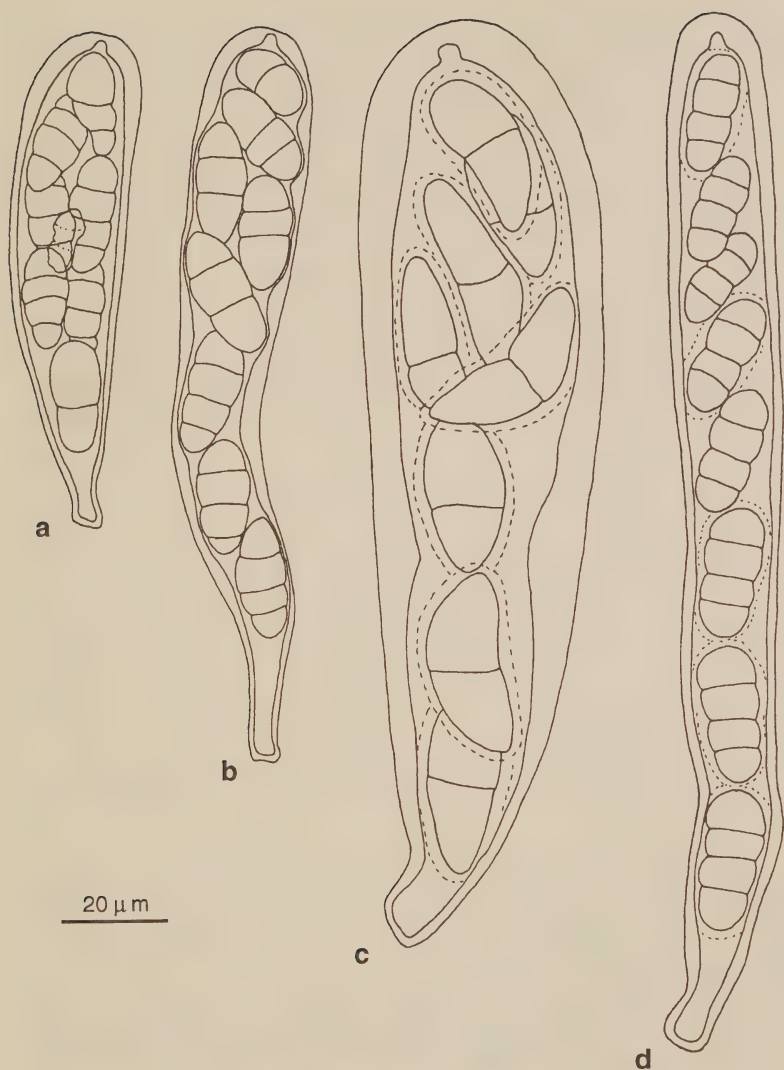


Fig. 4 — L'asque chez quelques *Weddellomyces*.
 a) *W. pachyosporicola*; b) *W. epicallopisma*; c) *W. macrosporus*
 (jeune asque à spores encore immatures); d) *W. aspiciliicola*.
 Matériel observé dans l'eau.

des coupes de jeunes périthèces propices à l'observation de l'origine des filaments interascaux. Cependant, la structure de l'hamathécium de *Weddellomyces* suggère qu'il est plutôt formé d'un réseau de paraphysoides que de véritables pseudoparaphyses.

Asques (fig. 3 et 4) bituniqués, cylindriques, subcylindriques ou claviformes—allongés, pédonculés, à endoascus épais, contenant de 4 à 8 spores. Partie supérieure de l'asque nettement épaissie (tholus), contenant une chambre oculaire munie d'une nasse apicale bien visible sur le matériel vivant.

Spores (fig. 5–16) d'un brun doré, ellipsoïdales ou subfusiformes, de dimensions très diverses selon les espèces, à (1)2–3(5) cloisons transversales, exceptionnellement avec en outre une cloison longitudinale, à cellules souvent un peu inégales (une extrémité plus allongée et plus pointue que l'autre), à maturité plus ou moins rétrécies au niveau de la cloison.

Paroi des spores (fig. 6d) formée de couches généralement bien visibles, de l'extérieur vers l'intérieur (interprétation selon BELLEMÈRE 1994):

- Périspore, formée de deux couches bien distinctes l'une de l'autre:
 - Périspore externe, mince et peu distincte chez la plupart des espèces, plus rarement assez épaisse et formant un halo bien visible.
 - Périspore interne (correspondant essentiellement à l'exospore des auteurs, terme qui tend à être abandonné), pigmentée de brun, BCr+ et I+ (bleu), devenant lentement brun sombre après traitement par K ou I, responsable de l'ornementation sporale lorsqu'elle existe.
- Paroi intermédiaire (BELLEMÈRE 1993), très mince, non visible en microscopie optique, sauf par ses différenciations de la cloison (voir ci-dessous).

- Épispore (ou paroi propre) pigmentée de brun, BCr–.

- Espace périplasmique incolore (l'endospore n'est pas différenciée).

Cloisons des spores percées d'un pore central de 1–2 µm de diamètre ou même davantage (parfois caché par d'abondantes guttules cytoplasmiques), constituées par l'espace périplasmique, l'épispore et la paroi intermédiaire (voir ci-dessus) qui forme à la base de la cloison un torus plus ou moins arrondi (particulièrement bien développé chez quelques espèces) et se prolonge dans la cloison par une lame interloculaire.

Hôtes, parasitisme: Les espèces de *Weddellomyces* s'établissent sur des lichens des genres *Caloplaca* (*C. aurantia*, *C. flavescens*, *C. erythrocarpa*, *C. gr. variabilis*), *Protoblastenia* (rarement) et *Aspicilia* (*A. radiosa*, *A. gr. calcarea*).

Si HAWKSWORTH hésite en ce qui concerne la relation entre *Weddellomyces epicallopisma* et son hôte, dans sa publication de 1986, il est par

contre affirmatif et considère cette espèce comme franchement parasite en 1990. L'examen de nombreuses collections de *W. epicallopisma* nous a permis de confirmer le parasitisme agressif de cette espèce.

Chez *C. flavesceus*, les primordiums d'ascoms de *W. epicallopisma* apparaissent dans la médulle du thalle ou du bord thallin de l'apothécie, sans qu'aucun dégât soit apparent au début. Puis, les périthèces crèvent le cortex de l'hôte tandis que le thalle environnant commence à blanchir par suite de la nécrose du cortex; en même temps la couche algale est altérée. Les taches blanches, d'abord localisées, deviennent ensuite confluentes.

Chez *C. aurantia*, dont le cortex est beaucoup moins résistant que celui de *C. flavesceus* en raison de sa structure (voir CLAUZADE et ROUX 1985: 233), le thalle blanchit rapidement, et il apparaît très tôt une zone blanchâtre bien visible, dépourvue de cortex et de couche algale, souvent étendue, sur laquelle se détachent les ascoms noirs du parasite.

HAWKSWORTH (1990) considère également *W. macrospora* comme un parasite qui provoque une altération visible du thalle de l'hôte.

Quant aux autres espèces considérées dans le présent travail, nous avons noté que les thalles qui les hébergent sont généralement en mauvais état. Mais, en raison du peu de matériel disponible, il ne nous est pas possible de préciser si ces *Weddellomyces* provoquent l'altération des thalles ou s'ils s'établissent sur des thalles déjà en mauvais état.

Clé de détermination des espèces de *Weddellomyces*

(à l'exclusion des espèces dépourvues de plaques céphalothécioïdes)

- 11 Spores 40–66 x 12–20 µm, à rapport longueur/largeur d'environ 3–4, 3-septées, munies d'un halo épais (atteignant 10 µm). Asques de 125–170 x 35–40 µm. — Parasite d'*Aspicilia calcarea*—

W. macrosporus

- 1 Spores plus petites, à rapport longueur/largeur < 3, entourées d'un halo de 0,5–3 µm d'épaisseur, généralement peu visible.

33 Spores mûres à surface lisse ou très finement granuleuse. Jeunes spores à cloisons munies d'un torus proéminent.

44 Spores 30–40 x 11–15 µm, d'un brun uniforme, à paroi d'épaisseur égale, (1)3 septées. Asques de 130–160 x 20–24 µm. — Parasite de *Caloplaca erythrocarpa*—

W. erythrocarpae

- 4 Spores 26–36 x 11–13 µm, à cellules apicales nettement plus claires que les médianes et à paroi nettement amincie. Asques

d'environ 100–150 x 20–26 μm . — Parasite d'*Aspicilia calca-rea* — ***W. heterochrous***

- 3 Spores mûres à surface nettement granuleuse-verruqueuse. Jeunes spores à torus non proéminents, souvent peu visibles.

44 Spores brun sombre ou noires à maturité, de 21–31 x 9–13 μm , 3-septées, généralement unisériées. Asques de 100–200 x 16–22 μm , cylindriques. — Allemagne, Slovaquie.

Parasite d'*Aspicilia radiosa* — ***W. aspiciliicola***

- 4 Spores brun clair ou brun doré (dans l'eau!), bisériées. Asques claviformes, ne dépassant pas 120 μm de longueur.

55 Spores 24–31 x 9–12 μm , 2–3(5)-septées. Asques 90–120 x 20–25 μm . — Parasite de *Caloplaca* gr. *aurantia*, *C.* gr. *variabilis* et de *Protoblastenia rupestris* —

W. epicallopisma

- 5 Spores 21–26 x 8–9,5 μm , (2)3(4)-septées. Asques 80–90 x 18–20 μm . — Parasite d'*Aspicilia* gr. *calcareo* —

W. pachyosporicola

Les espèces

Les caractères communs à toutes les espèces, déjà mentionnés dans la section Caractères généraux du genre *Weddellomyces*, ne sont pas répétés dans les descriptions qui suivent.

Weddellomyces epicallopisma (Weddell) D. Hawksw.

Notes RBG Edinb. 43(3): 512 (1986). — Bas. *Verrucaria epicallopisma* Weddell in *Mém. Soc. Nation. Sci. Nat. Cherbourg*, sér. 2, 7, 17: 372 (1873).

Iconographie: HAWKSWORTH (1986): habitus, structure de la paroi de l'ascome, des asques et des spores.

Ascomes (fig. 1) périthécioïdes, d'environ 0,3(0,4) mm de diamètre. **Asques** (fig. 3 et 4b) étroitement claviformes de 90–120 x 15–25 μm , contenant (4)–6–8 spores. **Spores** (fig. 5 et 6) de (21,5)24,5–27,8–31(38) x (9)9,5–10,7–12(13,5) μm (221 spores mesurées), munies de 2–3(5) cloisons transversales, d'un brun doré, ellipsoïdales, hétéropolaires (une extrémité arrondie, l'autre atténuée), légèrement rétrécies au niveau de la cloison médiane, à torus non proéminents, souvent peu visibles, à périspore interne nettement granuleuse-verruqueuse à maturité, entourées d'une mince périspore externe (d'environ 0,5 μm d'épaisseur).

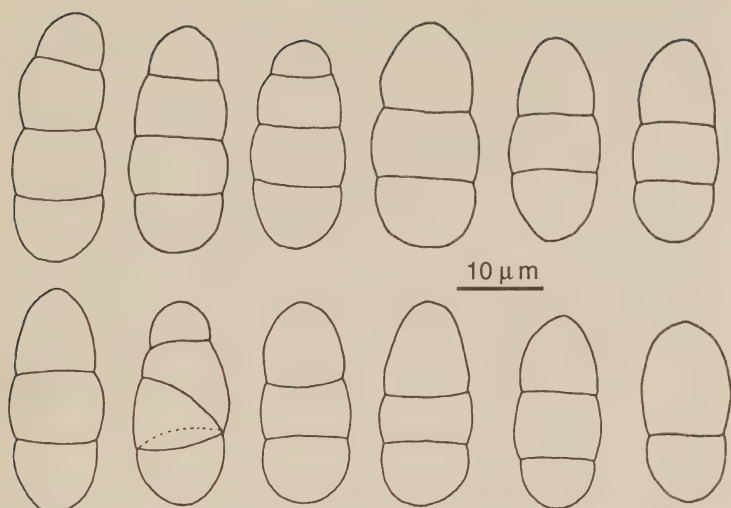


Fig. 5 — *Weddellomyces epicallipisma*. Variabilité de la forme et de la septation des spores (observées dans l'eau ; contenu non représenté).

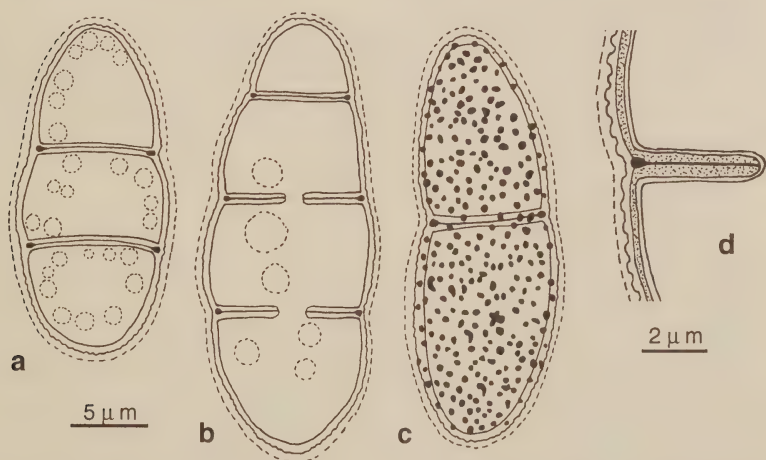


Fig. 6 — Spores de *Weddellomyces epicallipisma*. a et b) Structure. c) Ornementation de la paroi. d). Détail de la structure de la paroi et de la cloison de la spore. De l'extérieur vers l'intérieur : périspore externe (limitée par un trait pointillé vers l'extérieur), périspore interne, finement verruqueuse, BCr+ (bleu), épispore ou paroi propre (en pointillé, BCr-) et espace périplasmique (endospore non différenciée) ; dans la cloison, torus (rond noir) et lame interloculaire. Matériel frais observé dans l'eau.

Remarques : Les dimensions des spores des spécimens de *W. epicallopusma* étudiés concordent avec celles données par HAWKSWORTH (1986) ou leur sont légèrement supérieures.

Par contre, un spécimen, parasite de *Caloplaca* gr. *variabilis*, que nous nommons *Weddellomyces* cf. *epicallopusma*, diffère des *W. epicallopusma* typiques par des spores plus courtes : (20)22–23, 8–26 x 9–10, 1–11(12) μm (32 mesures, non considérées dans la description de *W. epicallopusma* s. s.). Pour l'instant, en l'absence d'autres spécimens semblables, il n'est pas possible de préciser si cette variation dans la dimension des spores correspond à un taxon particulier.

Répartition géographique et habitat : Jusqu'ici, *W. epicallopusma* était connu dans les îles britanniques (Angleterre et pays de Galles) et dans la localité type, dans le sud-ouest de la France, près de Poitiers (HAWKSWORTH 1986), ainsi qu'en Sardaigne (NIMIS et POELT 1987) et en Allemagne (Bade-Wurtemberg : HAWKSWORTH et DIEDERICH 1991), dans tous les cas sur *Caloplaca aurantia* et *C. flavescens*.

Nos spécimens parasitent le thalle de divers *Caloplaca*, le plus souvent *C. aurantia*, parfois *C. flavescens*, mais également *Caloplaca chalybaea* et même *Protoblastenia rupestris*, hôtes nouveaux de *W. epicallopusma*. Sur *C. gr. variabilis* on rencontre une forme particulière (voir section ci-dessus, Remarques).

W. epicallopusma s'établit dans des biotopes ensoleillés, sur des roches calcaires, dans des milieux riches en nitrates et autres substances d'origine anthropozoïque, plus particulièrement sur pierres, ciment ou béton des murs, au bord de chemins, ou sur parois rocheuses.

Matériel étudié :

Espagne, Catalogne. — Prov. Barcelona, Anoia, Castellolí : Port dels Brucs, UTM 31TCG9405, 600 m, leg. P. NAVARRO-ROSINÉS et A. SÁNCHEZ-CUIXAR, 20.II.1992 (BCC.–lich.). Parasite d'un thalle de lichen stérile, en mauvais état, blanc, identique à un thalle voisin, fertile, appartenant à *Protoblastenia rupestris*. — Prov. Lleida, Segarra, Cervera, camino a Mas Solsona, UTM 31TCG5615, 550 m, leg. P. NAVARRO-ROSINÉS, 22.V.1993 (BCC.–lich.). Parasite de *Caloplaca aurantia*.

France, Provence. — Alpes-de-Haute-Provence, Oppedette, canyon d'Oppedette, non loin du belvédère, rive gauche, 500 m; leg. C. ROUX, 21.IX. 1976 (MARSSJ, herb. C. ROUX). Parasite de *Caloplaca chalybaea*. — Bouches-du-Rhône, Châteauneuf-les-Martigues, 50 m; leg. C. ROUX et P. NAVARRO-ROSINÉS, 25.XI.1989 (BCC–lich.). Spécimen peu développé, parasite de *Caloplaca aurantia*. — Bouches-du-Rhône, Marseille, vallon de l'Herbe, chemin du mont Puget, 350 m, leg. C. ROUX et P. NAVARRO-ROSINÉS, 16.V.1993 (BCC–Lich.; MARSSJ, herb. C. ROUX). — Bouches-du-Rhône, Mimet, col Sainte-Anne, à l'W du

Pilon-du-Roy, 600–650 m; leg. C. ROUX et P. NAVARRO-ROSINÉS, 10.IV.1993 (BCC-lich., MARSSJ, herb. C. ROUX). Parasite de *Caloplaca aurantia*. — Vaucluse, Gordes, col de Gordes, 350 m; leg. C. ROUX et P. NAVARRO-ROSINÉS, 14.V.1993 (BCC-lich.; MARSSJ, herb. C. ROUX). Parasite de *Caloplaca aurantia*. — Vaucluse, Sivergues, paroi de mortier sur le mur d'une maison du village, 500 m; leg. G. CLAUZADE, C. ROUX, M. GLENN et P. NAVARRO-ROSINÉS, 10.VI.1993 (BCC-lich.; MARSSJ, herb. C. ROUX). Parasite de *Caloplaca flavescens*.

Weddellomyces cf. epicallopisma

Espagne, Catalogne, Prov. Tarragona, Baix Penedès, el Montmell: Barranc del Prat, UTM 31TCF7175–7176, 400–500 m; leg. M. GIRALT, A. GÓMEZ-BOLEA et P. NAVARRO-ROSINÉS, 21.II.1988 (BCC-lich.). Parasite de *Caloplaca* gr. *variabilis* (voir plus haut, section Remarques).

***Weddellomyces erythrocarpae* Nav.–Ros. et Roux sp. nova**

Weddellomyces epicallopisma similis, sed sporae majores, 30–40 µm longae et 11–15 µm latae, tenuiter in interna perispora granulosae, primo instructae toris proeminentibus. Immersus in thallo Caloplacae erythrocarpae.

Typus : Hispania, Catalonia, prov. Tarragona, Ribera d'Ebre, Tivissa : Barranc del Montalt, prope la Serra d'Almós, UTM 31T CF1348–1448, 300–400 m; leg. M. GIRALT, A. GÓMEZ-BOLEA et P. NAVARRO-ROSINÉS, 2.VI.1988 (BCC-lich.).

Ascomes périthécioïdes, de 0,2–0,45 mm de diamètre. **Asques** claviformes, de 130–160 × 20–24 µm, contenant 6–8 spores. **Spores** (fig. 7 et 8) de (28,5)30–34, 7–40(45) × (10)11–12, 9–15(15,5) µm (30 spores mesurées), à (1)2(3) cloisons transversales, de couleur brun doré, ellipsoïdales, légèrement hétéropolaires, rétrécies au niveau des cloisons à maturité, au début munies chacune d'un torus proéminent, à périspore interne très finement granuleuse, entourées d'une mince périspore externe de 0,5(1) µm d'épaisseur.

Remarques : Cette espèce se rapproche de *W. macrosporus* par sa paroi très finement granuleuse, mais s'en distingue par des spores nettement plus petites, à périspore externe mince et peu distincte. Elle s'éloigne de *W. epicallopisma* par des spores plus grandes, à ornementation beaucoup plus fine. Les jeunes spores de *W. erythrocarpae* présentent un torus épais et proéminent, caractère qui existe également, mais à un degré moindre, chez *W. heterochrous* et *W. macrosporus*.

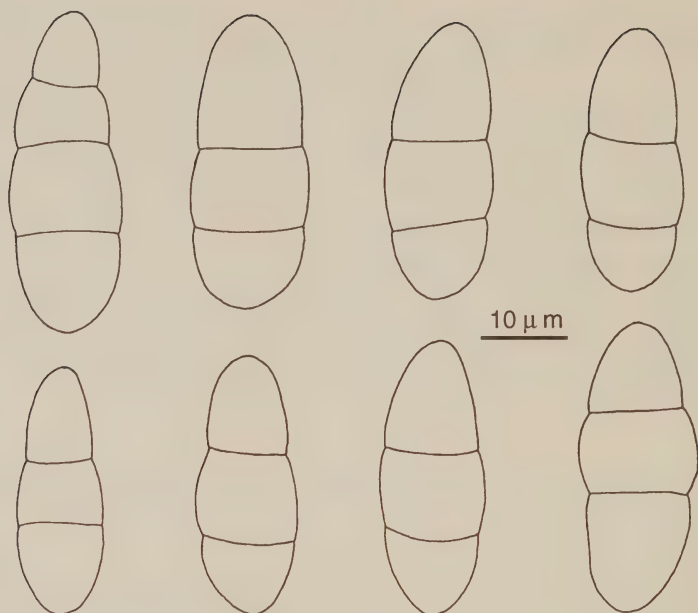


Fig. 7 — *Weddellomyces erythrocarpae*. Variabilité de la forme et de la septation des spores (observées dans l'eau).

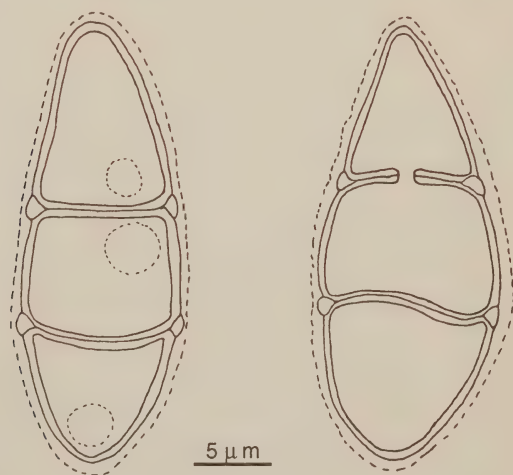


Fig. 8 — *Weddellomyces erythrocarpae*. Structure de jeunes spores, à torus proéminents. Matériel observé dans l'eau.

Répartition géographique et habitat: *Weddellomyces erythrocarpae* n'est connu que dans la localité type. Il s'établit sur des thalles en mauvais état de *Caloplaca erythrocarpa*, sur des surfaces planes ou peu inclinées de blocs et dalles calcaires.

***Weddellomyces heterochrous* Nav.-Ros. et Roux sp. nova**

Weddellomyces epicallopisma similis, sed sporae majores, 26–36 µm longae et 11–14 µm latae, in septo constrictae, primo halonatae et proeminentibus toris instructae, cum interna perispora distincte tenuiter granulosa, et cum apicalium cellularum pariete minus incrassata atque colorata quam centralium. Immersus in thallo Aspicilliae calcareae.

Typus : Hispania, Catalonia, prov. Tarragona, Ribera d'Ebre, Tivissa: Barranc del Montalt, prope la Serra d'Almós, UTM 31TCF1348–1448, 300–400 m; leg. M. GIRALT, A. GÓMEZ-BOLEA et P. NAVARRO-ROSI-NÉS, 2.VI.1988 (BCC–lich.).

Ascomes périthécioïdes, atteignant 0,3 mm de diamètre, peu abondants. **Asques** claviformes, d'environ 100–150 x 20–26 µm, au début octosporés, puis contenant de 4 à 8 spores mûres. **Spores** (fig. 9 et 10) ellipsoïdales, de (25)26,5–30,4–35,5(38) x (10)11–12–13,5(14,5) µm (34 spores mesurées), (2)3(5)–septées, exceptionnellement munies en outre d'une cloison longitudinale, d'un brun doré, mais à cellules apicales distinctement plus pâles et à paroi plus mince ($\leq 0,5$ µm contre 1–1,5 µm pour les cellules médianes), resserrées au niveau de la cloison à maturité, au début munies de torus proéminents, à périspore interne lisse ou très finement granuleuse, entourées d'une périspore externe mince (≤ 1 µm), peu visible.

Remarques : *W. heterochrous* est bien distinct des autres espèces du genre par ses spores à cellules apicales claires et à paroi mince, bien différentes des cellules médianes. Cette faible épaisseur de la paroi des cellules apicales concerne la périspore interne et l'épispore. Ce caractère n'est cependant pas constant : quelques spores peuvent être uniformément brunes, ou présenter une seule cellule plus claire. En outre les spores traitées par K ou en mauvais état sont uniformément brunes.

Répartition géographique et habitat : *Weddellomyces heterochrous* n'est connu que dans la localité type, sur thalle d'*Aspicillia calcareae*, sur bloc de roche calcaire compacte et très cohérente.

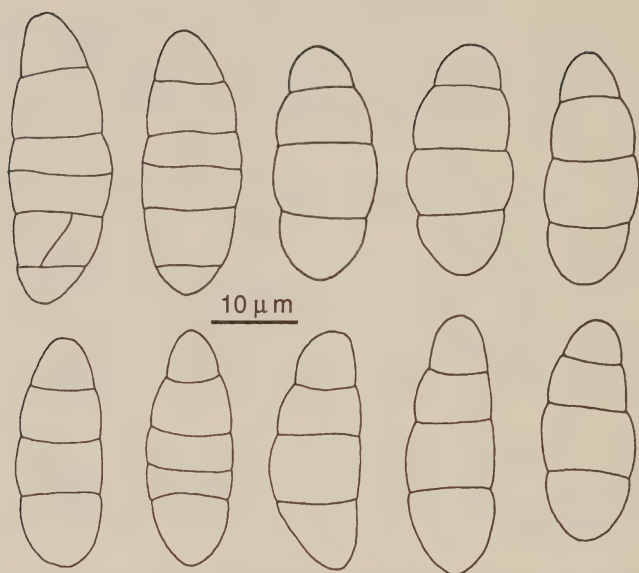


Fig. 9 — *Weddellomyces heterochrous*. Variabilité de la forme et de la septation des spores (observées dans l'eau).

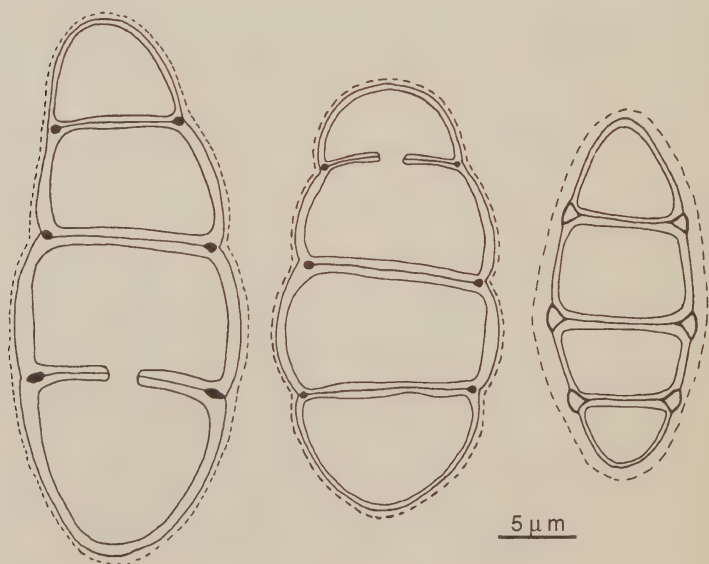


Fig. 10 — *Weddellomyces heterochrous*. Structure des spores observées dans l'eau). À droite, jeune spore à torus saillants.

Weddellomyces macrosporus D. Hawksw., Renobales et Coppins

Notes RBG Edinb. **46**(3): 400 (1990) [sub *Weddellomyces macrospora*].

Iconographie : HAWKSWORTH (1990) : spores. RENOBALLES (1987) : coupe d'ascome, asque et spores (sub *Leptosphaeria* sp.).

Ascomes périthécioïdes, de 0,2–0,4 mm de diamètre. **Asques** (fig. 4c) claviformes, 125–170 x 35–40 μm , contenant de 4 à 8 spores. **Spores** (fig. 11 et 12) ellipsoïdales ou subfusiformes, de (49)53–60,3–66(71) x (12)15–17,1–20(24) μm (43 spores mesurées), 3(4)–septées, d'un brun doré, un peu hétéropolaires, resserrées au niveau de la cloison à maturité, au début munies de torus proéminents, à périspore interne finement granuleuse, entourées d'une périspore externe épaisse (halo atteignant 8 μm), bien visible.

Remarques : *Weddellomyces macrosporus* se distingue aisément des autres espèces du genre par des spores nettement plus grandes, plus allongées (rapport longueur/largeur d'environ 3–4; inférieur à 3 chez les autres espèces) et par une périspore épaisse, formant un halo bien distinct, au moins chez les jeunes spores.

La présence d'un halo épais et d'un sporoplasme très dense et riche en fines gouttelettes rend difficile l'observation des pores des cloisons des spores de cette espèce. Néanmoins nous avons observé quelques-uns de ces pores après coloration par le bleu au lactophénol.

Répartition géographique et habitat : Jusqu'ici, cette espèce n'était connue que dans le pays de Galles et dans le Pays Basque, sur le thalle d'*Aspicilia calcarea* (HAWKSWORTH, 1990), ainsi qu'en Allemagne (HAWKSWORTH et DIEDERICH 1991), sur *Aspicilia radiosa* [matériel à spores de dimensions plus petites que celles indiquées par HAWKSWORTH (1990) et que celles de nos spécimens].

Le spécimen de Catalogne parasitait un thalle d'*Aspicilia calcarea* en mauvais état, sur la surface horizontale du sommet d'un gros bloc rocheux.

Matériel étudié : Espagne, Catalogne, Prov. Tarragona, Montsianés, La Sénia : les Vallcaneres Altes (Serra dels Ports), UTM 31TBF7015–7115, 1200 m; leg. M. BOQUERAS, A. GÓMEZ–BOLEA et P. NAVARRO–ROSINÉS, 14.II.1987 (BCC.–lich.).

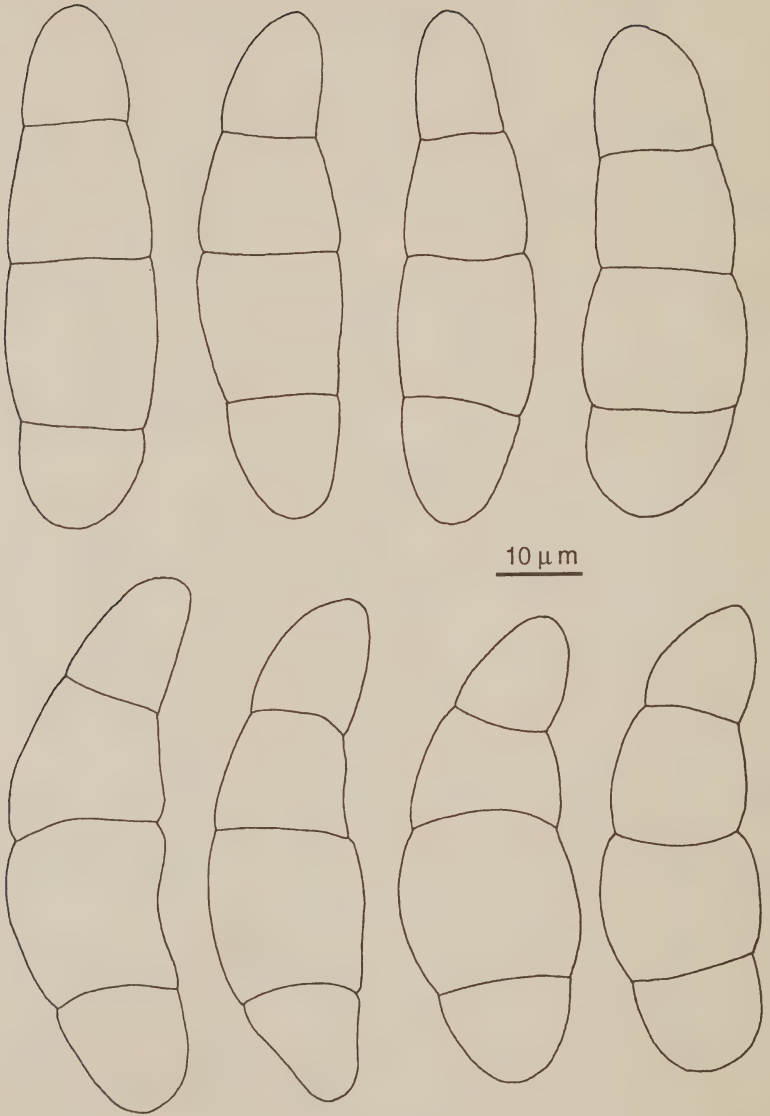


Fig. 11 — *Weddellomyces macrosporus*. Variabilité de la forme et de la septation des spores (observées dans l'eau).

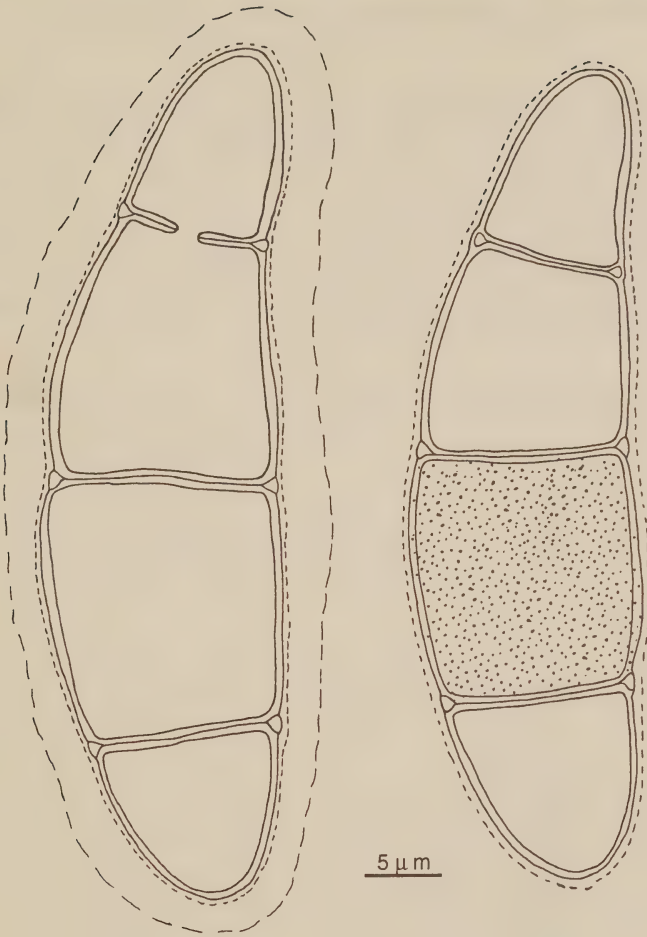


Fig. 12 — *Weddellomyces macrosporus*. Structure des spores et de l'ornementation de leur paroi (matériel observé dans l'eau; ornementation de la paroi représentée seulement sur une cellule médiane de la spore de droite; contenu des spores non représenté).

***Weddellomyces pachyosporicola* Nav.-Ros. et Roux sp. nova**

Weddellomyces epicallopisma similis interna perispora distincte granuloso-verrucosa, sed ei dissimilis sporis minoribus, 20–26 µm longis et 8–10 µm latis. Immersus in thallo Aspicilliae contortae et Aspicilliae coronatae.

Typus : Hispania, Catalonia, prov. Tarragona, Priorat, la Torre de Fontaubella, loco dicto Collet de la Plana d'en Cervera, UTM 31TCF2154–2253, 500–550 m; leg. M. GIRALT et P. NAVARRO-ROSINÉS, 13.XI.1987 (BCC.–lich.). Parasitus in thallo Aspicilliae coronatae, in vicinitate thalli Caloplacae alocizae.

Ascomés périthécioïdes, de 0,1–0,3 mm de diamètre. **Asques** (fig. 4a) claviformes, 80–90 x 18–20 µm, contenant (4)8 spores. **Spores** (fig. 13 et 14) ellipsoïdales, de (20)21–23,8–26(30) x (7)8–8,7–9,5(10) µm (59 spores mesurées), (1)3(4)–septées, d'un brun doré, un peu hétéropolaires, resserrées au niveau de la cloison à maturité, à torus non proéminents, souvent peu visibles, à périspore interne nettement granuleuse-verruqueuse, entourée d'une périspore externe mince (≤ 0,5 µm), peu visible.

Remarques : Cette espèce, très proche de *W. epicallopisma* par sa périspore interne distinctement granuleuse-verruqueuse, s'en distingue néanmoins par des spores et des asques nettement plus petits, ainsi que par un parasitisme sur les *Aspicilia* du sous-genre *Pachyospora*.

Les dimensions des spores de *W. pachyosporicola* sont proches de celles de *Leptosphaeria crozalsii* Vouaux, espèce que certains auteurs considèrent comme appartenant probablement au genre *Weddellomyces* (HAWKSWORTH, 1990 ; ALSTRUP et HAWKSWORTH, 1990 ; HAWKSWORTH et DIEDERICH, 1991). Cependant, selon nos observations (NAVARRO-ROSINÉS et ROUX, article en préparation), *L. crozalsii* appartient en fait au genre *Pyrenidium* Nyl.

Répartition géographique et habitat : *W. pachyosporicola* n'est connu que dans deux stations de Catalogne, mentionnées dans ce travail. Il parasite des thalles en mauvais état d'*Aspicilia contorta* et d'*A. coronata*, sur des surfaces peu inclinées de blocs calcaires.

Autre matériel étudié : Espagne, Catalogne, prov. Tarragona, Baix Ebre, Roquetes : Barranc de la Caramella (Serra dels Ports), UTM 31TBF7920–7919, 400–500 m; leg. M. BOQUERAS, A. GÓMEZ-BOLEA et P. NAVARRO-ROSINÉS, 19.X.1986 (BCC.–lich.). Parasite du thalle d'*Aspicilia contorta*.

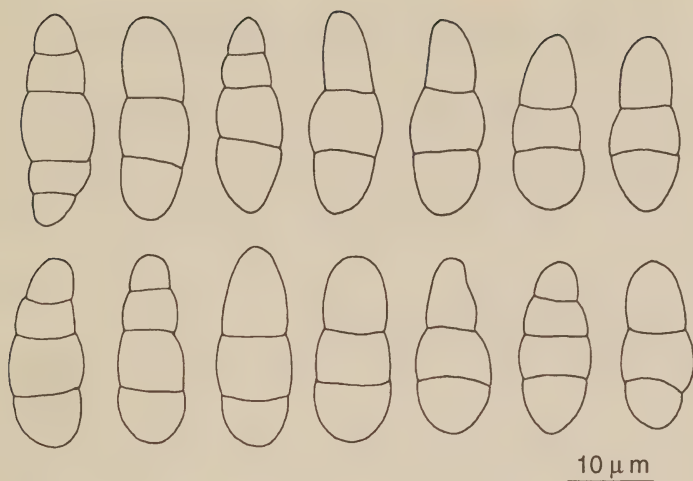


Fig. 13 — *Weddellomyces pachyosporicola*. Variabilité de la forme et de la septation des spores (observées dans l'eau).

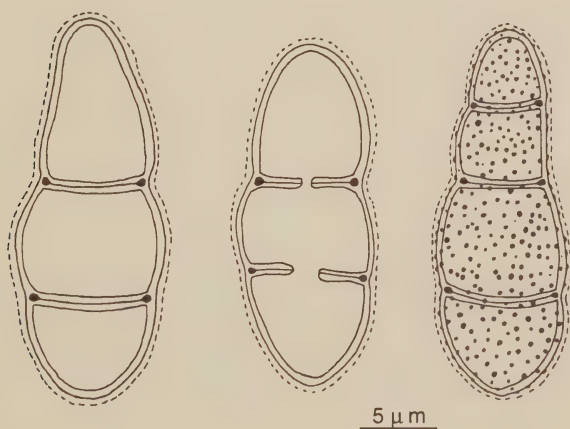


Fig. 14 — *Weddellomyces pachyosporicola*. Structure des spores et de l'ornementation de leur paroi (matériel observé dans l'eau ; ornementation de la paroi représentée sur la spore de droite ; contenu des spores non représenté).

Annexe : *Weddellomyces aspiciliicola* Alstrup

En Europe, outre les espèces qui viennent d'être décrites, on ne connaît qu'un seul autre *Weddellomyces* s. s. (à plaques céphalothécioïdes) : *W. aspiciliicola* Alstrup (1992). Cette espèce a été intégrée dans la clé de détermination des espèces de *Weddellomyces* (voir plus haut) et nous en donnons ci-après une description illustrée, à fin de comparaison avec les espèces de Catalogne et de Provence.

Weddellomyces aspiciliicola Alstrup

Folia Geobot. Phytotax. **27**:185 (1992).

Iconographie. — ALSTRUP (1992) : sommet des asques et spores.

Ascomés périthécioïdes, d'environ 0,4 mm de diamètre. **Asques** (fig. 4d) (100)130–180(200) × (16)18–22 µm, cylindriques ou presque cylindriques, contenant 8, plus rarement 4 spores, presque toujours unisériées. **Spores** (fig. 15 et 16) ellipsoïdales, de (21)23–25,9–28,5(30) × (9)9,5–10,9–12(13) µm (35 spores mesurées), 3–septées, d'abord d'un brun doré puis devenant brun sombre, resserrées au niveau des cloisons, plus particulièrement à la cloison médiane, munies de torus peu ou pas proéminents, à paroi épaisse, à périspore interne nettement granuleuse, entourée d'une épispore atteignant 3 µm, bien visible. Parfois, les cellules apicales des spores sont plus claires que les médianes. En outre, les pores des cloisons semblent particulièrement larges (pouvant atteindre plus de la moitié du diamètre de la cloison).

Remarques : *Weddellomyces aspiciliicola* est bien caractérisé par des asques étroitement cylindriques ou presque cylindriques et par des spores presque toujours unisériées, à paroi épaisse, brun sombre à maturité, entourées d'un halo bien visible.

Répartition géographique et habitat : Cette espèce n'est connue qu'en Slovaquie (ALSTRUP 1992) et en Allemagne (HAWKSWORTH et DIEDERICH 1991, sub *Weddellomyces* sp.), sur le thalle d'*Aspicilia radiosa*.

Matériel étudié : Slovaquie, Stiavinské vrchy Mts., "Kamenné more" reservation near Vyhne, boulder scree (rhyolite) SE-slope of Mt. Kamenná, 400 m alt.; leg. V. ALSTRUP, 31.X.1991 (C, holotypus).

Discussion et conclusions

À l'issue de cette étude, le genre *Weddellomyces* nous semble bien caractérisé notamment par des ascomés périthécioïdes à paroi formant des plaques céphalothécioïdes et par des spores brunes, presque toujours pourvues seulement de cloisons transversales, exceptionnelle-

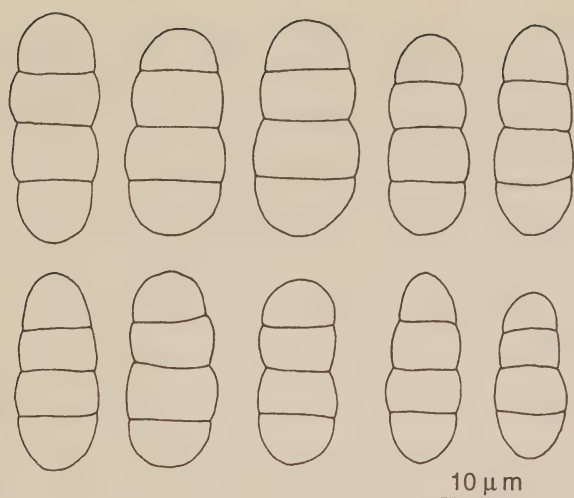


Fig. 15 — *Weddellomyces aspiciliicola*. Variabilité de la forme et de la septation des spores (observées dans l'eau).

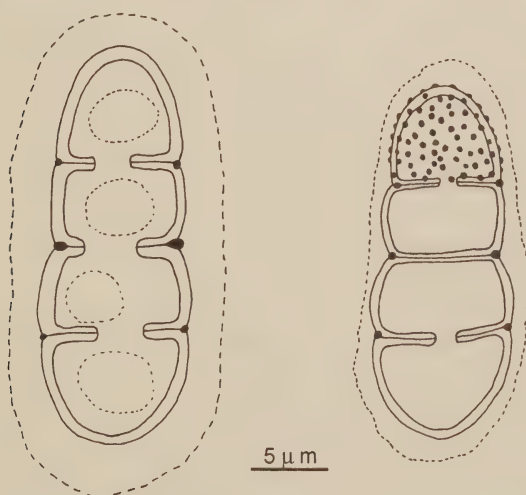


Fig. 16 — *Weddellomyces aspiciliicola*. Structure des spores et de l'ornementation de leur paroi (matériel observé dans l'eau; ornementation de la paroi représentée seulement sur la cellule apicale de la spore de droite).

ment avec en outre une cloison longitudinale. L'élargissement du concept générique à des espèces dépourvues de plaques céphalothécioïdes (ALSTRUP et HAWKSWORTH 1990), déjà considéré comme discutable par ROUX et BELLEMÈRE (1991), nous semble rendre la définition du genre confuse et d'application incertaine. Nous préférons donc nous en tenir au concept initial d'HAWKSWORTH (1986).

Des ascomés à paroi formant des plaques céphalothécioïdes se rencontrent également dans le genre *Zopfioloveola* D. Hawksw. (Zopfiaceae), mais n'existent pas chez les Dacampiaceae où le genre *Weddellomyces* a pourtant été placé (ERIKSSON et HAWKSWORTH 1993).

Parmi les Dacampiaceae lichénicoles à spores pluriseptées, *Pyrenidium* se distingue de *Weddellomyces* (outre l'absence de plaques céphalothécioïdes) par des spores à cellules apicales à extrémité distale très amincie et presque incolore (à épispore très mince), ainsi que par des périthèces à périphyses rudimentaires de teinte vert-bleu (NAVARRO-ROSINÉS et ROUX, article en préparation). Selon HAWKSWORTH (1983) le genre *Pyrenidium* est en outre caractérisé par des spores à septums munis d'un pore central, pore qui, selon ce même auteur, manque chez *Weddellomyces epicallopisma* (HAWKSWORTH 1986: 517), le type du genre *Weddellomyces*. Comme nous avons observé de tels pores (toutefois un peu moins visibles que chez les *Pyrenidium*) chez tous les *Weddellomyces* étudiés, ce caractère ne peut être utilisé pour distinguer les deux genres. À ce propos, l'appartenance au genre *Pyrenidium* de *P. hyalosporium* Alstrup, D. Hawksw. et R. Sant., récemment décrit (ALSTRUP et HAWKSWORTH, 1990), nous semble discutable, car cette espèce diffère notablement de l'espèce type (*P. actinellum* Nyl.), notamment par des spores incolores, munies d'un pore germinatif apical et dont les cloisons sont dépourvues de pores. D'ailleurs, selon GRUBE et HAFELLNER (1990: 294 et 353, fig. 41), cette espèce est plus proche des *Zwackhiomyces* et des *Didymellopsis* (à spores incolores) que des *Weddellomyces*.

Dacampia se distingue de *Weddellomyces* non seulement par la structure de la paroi des ascomés, mais également par des spores sub-murales ou murales, dont les cloisons semblent dépourvues de pores (CRIVELLI 1983 et observations personnelles). Par ailleurs, chez *Dacampia*, le pigment des cellules de la paroi des ascomés se présente sous forme de granules très distincts, tandis qu'il semble amorphe chez les *Weddellomyces*. HAWKSWORTH (1986), citant CRIVELLI (1983), indique également que la structure du sommet de l'asque est plus complexe chez *Dacampia* que chez *Weddellomyces*, cependant nous n'avons pu observer une telle différence chez ces deux genres.

Clypeococcum D. Hawksw. (HAWKSWORTH 1977 et 1980, GRUBE et HAFELLNER 1990, ØVSTEDAL et HAWKSWORTH 1986, TRIEBEL 1989), classé également dans les Dacampiaceae, se distingue des *Weddellomyces* et des genres examinés ci-dessus par des spores uniseptées et surtout par des périthèces réunies, de quelques-uns à une vingtaine, sous un clypéus (formation stromatique en forme de bouclier, recouvrant un ou plusieurs périthèces ou pycnides), périthèces ostiolés, bien entendu dépourvus de plaques céphalothécioïdes, dont la paroi a, au moins au début, une *textura intricata*.

Enfin, le genre *Leptosphaeria*, qui présente également des spores plus ou moins brunes et à cloisons transversales, a été récemment placé dans les Leptosphaeriaceae (BARR 1987, ERIKSSON et HAWKSWORTH 1993). Ce genre, qui comprend des espèces essentiellement saprophytes, se rencontrant surtout sur des dicotylédones herbacées, se distingue des Dacampiaceae notamment par des ascomes à paroi scléroplectenchymateuse, épaisse latéralement mais mince à la base, et par des asques à anneau apical amyloïde (MATZER et HAFELLNER 1990). Il est vraisemblable que toutes les espèces lichénicoles rapportées au genre *Leptosphaeria* (CLAUZADE et al. 1989) devront en être exclues. C'est ainsi que *Leptosphaeria crozalsii* doit être placé parmi les *Pyrenidium* (NAVARRO-ROSINÉS et ROUX, en préparation).

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THE GENUS *PLUTEUS* SECTION *PLUTEUS* (PLUTEACEAE, AGARICALES) IN THE MIDWESTERN UNITED STATES

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ABSTRACT

The genus *Pluteus* section *Pluteus* (Pluteaceae, Agaricales) from the midwestern United States includes fourteen species and three varieties. In addition, four extralimital U.S. species are reported. *Pluteus cinerascens*, *P. heterocystis*, *P. laricinus*, and *P. salicinus* var. *americanus* are reported as new. In addition, *P. atricapillus* and *P. brunneidiscus* are reported for the first time from the study area, and *P. patricius*, *P. pellitus*, and *P. petasatus* are reported for the first time from Illinois. Detailed morphological and anatomical examinations of basidiomata reveal two broad groups: taxa with *cervinus*-type (with apical projections) and *magnus*-type (without apical projections) pleurocystidia. A detailed key to all taxa of *Pluteus* section *Pluteus* of the U.S. is presented. Data obtained from the studied collections were included in cladistic analyses, and phylogenetic relationships among the North American taxa were elucidated. Monophyly of most taxa was not supported by the analyses. *P. atromarginatus* and *P. atropungens* were always clustered in one group, and *P. salicinus* and its two varieties (var. *achloes* and var. *americanus*) were clustered in another group. *P. brunneidiscus*, *P. washingtonensis*, and *P. heterocystis* were always associated with the *P. salicinus* group suggesting close evolutionary relationships with the latter. The proximity of *P. brunneidiscus* and *P. washingtonensis* with the *P. salicinus* group probably reflects phylogenetic significance among species with clamp connections in the pileipellis.

Key Words: Cladistics, morphology, phylogeny, *Pluteus*, Pluteaceae, taxonomy.

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INTRODUCTION

The genus *Pluteus* Fr. (Pluteaceae, Agaricales) is a large group of mushrooms characterized by the following features: habit pluteoid—stipe central; lamellae free, white when young, pink to brownish pink when mature; annulus and volva absent; context of the pileus most frequently white, consisting of fleshy, inamyloid tissue. Basidia usually 4-sterigmate, clavate; basidiospores pinkish brown in mass, with cyanophilic walls, smooth, inamyloid, hyaline in KOH, germ pores absent, usually lacking suprahilar depression or applanation, hilar appendix conspicuous or inconspicuous; hymenophoral trama inverse, homoiomerous; hyphae inamyloid, with or without clamp connections. Pileipellis a palisadoderm of sphaeropedunculate cells or a trichoderm of filamentous hyphae with allantoid or cylindric-fusoid end cells. Species of *Pluteus* are presumed to be saprophytic.

Noteworthy taxonomic works on *Pluteus* in the nineteenth and early twentieth centuries include those of Fries (1821), Fayod (1889), and Murrill (1917), and, in the last four decades, those of Kühner and Romagnesi (1953), Singer (1956, 1958), Smith and Stuntz (1958), Homola (1972), Vellinga and Schreurs (1985), and Orton (1986). These articles have led to the current acceptance of three sections in *Pluteus*—sections *Celluloderma*, *Hispidoderma*, and *Pluteus*—based on structure of the pileipellis and the nature of pleurocystidia. A palisadoderm of sphaeropedunculate cells makes up the pileipellis of species in section *Celluloderma* while the other two sections exhibit a trichoderm of filamentous hyphae with allantoid or cylindric-fusoid end cells (Homola, 1972). Members of section *Pluteus* differ from those of section *Hispidoderma* by the presence of metuloids (i.e., thick-walled) and thin-walled pleurocystidia, respectively.

The fleshy mycota of the American lower midwestern region is not well known (Sundberg, 1984). A survey of herbarium collections and discussions with other workers indicate the regional *Pluteus* mycota to be much larger than previously reported. This project was therefore undertaken to complete an intensive examination of members of the genus *Pluteus* section *Pluteus* occurring in some midwestern regions of the United States.

Luttrell (1958) characterized taxonomy as a discipline with two

functions—to provide an index to species through naming, classification and identification, and to show phylogeny. Phylogeny of basidiomycetes has been hypothesized by many workers (e.g., Savile, 1955; Smith, 1971; Singer, 1986; Vilgalys, 1986; Mueller, 1992). Because no attempt has been made to elucidate phylogenetic relationships in the genus *Pluteus* using cladistics or any other quantitative method, phylogenetic analyses were conducted using morphological and anatomical characters including all species in section *Pluteus* found in the continental United States.

MATERIALS AND METHODS

Personal collections were made from the midwestern regions of the United States including Illinois, Indiana, Missouri, western Kentucky, and western Tennessee. Available type specimens and other dried collections including material from Michigan housed at various herbaria were also studied. The ancillary specimens also included collections from other parts of the U.S. and some temperate European countries.

Collections were made and studied using standard techniques (Smith, 1949; Largent, 1973; Singer, 1986). Descriptions of morphological characters were made for each collection along with notes on habitat and phanerogamic affinities. Descriptive terms employed were taken from Snell and Dick (1971) and Largent (1973).

After morphological notes were taken on fresh collections, basidiomata were preserved and deposited at Southern Illinois University at Carbondale herbarium (SIU). Anatomical data were based on a complete, detailed examination of representative collections (Largent et al., 1977). The number of collections examined was dependent upon the availability of material and amount of variability encountered within a taxon. Measurements were made from several basidiomata per collection. A Leitz binocular bright-field microscope was used, and illustrations of characters were made both by hand and with the aid of a Leitz drawing tube.

In the descriptions of taxa, all qualitative and quantitative evaluations are from multiple observations of one (where only the type was studied) or several (where the type and/or other specimens were studied) collections. Fruiting seasons for the taxa are recorded. Characters that are generic in nature and consistent for all species (e.g., free lamellae, pinkish

brown basidiospores, etc.) are not repeated in the descriptions.

Color names in quotes (followed by abbreviated reference) are from Ridgway (R, 1912), Kornerup and Wanscher (K&W, 1967), Kelly and Judd (NBS, 1976), or Henderson et al. (RBG, 1969). Names not in quotes are author-generated.

The herbarium abbreviation for collections examined is given in parentheses after the collection number (Holmgren, et al., 1990). For American states, the standard two-lettered abbreviations are used.

Characters Used in taxonomy of *Pluteus*.—Many *Pluteus* taxa look similar on superficial examination. However, closer examination of the macroscopic and microscopic characters readily permits differentiation of taxa in the genus. The following are important delimiting characters in *Pluteus* section *Pluteus* taxonomy.

Basidiome color.—Pileus, stipe and lamellar colors are the most diagnostic macroscopic morphological characters. In section *Pluteus*, the most common pileus color is brown. However, white basidiomata are also observed. An assumption was made that dark color represents the plesiomorphic state and light color the apomorphic state (for details, see section on phylogenetic analyses).

Hygrophany is uncommon in section *Pluteus*. It is observed only in *P. salicinus* (Pers.: Fr.) Kumm. and some of its varieties.

Taxa of *Pluteus* section *Pluteus* exhibit pinkish to brownish pink lamellae with either a concolorous or dark-colored margin. Marginate lamellae result from the presence of cheilocystidia with a brown homogeneous content. The non-marginate condition is more common.

Basidiome size.—Even though basidiome size is often variable due to differences in age and environmental conditions, it can be diagnostic in some cases. Most taxa in section *Pluteus* have mature basidiomata of moderate size (pileus 3-10 cm wide). Specimens of *Pluteus cervinus* (Schaeff.: Fr.) Kumm., *P. magnus* McClatchie, *P. patricius* (Schulz. in Kalchbr.) Boud. in Sacc., and *P. petasatus* (Fr.) Gill. have occasionally been observed to be very large. Stipe size is directly proportional to the size of the pileus.

Scales on basidiome.—Scales are found on pileus, especially on the disc, in some species (e.g., *P. patricius* and *P. atricapillus* [Batsch] Fayod) and on stipe on some others (e.g., *P. cervinus* var. *scaber* Lange). Because most species lack them, presence of scales can be an important

distinguishing feature.

Pileipellis.—In section *Pluteus*, the elements of the pileipellis, which form a loose trichoderm, are erect or suberect fascicles of long hyphae with or without a dark homogeneous content. The presence or absence of clamp connections on these elements is an important delimiting character. Various authors (Smith, unpublished; Singer, 1956; Vellinga in Bas, 1990) have proposed the creation of subsections or stirpes based on the presence or absence of clamp connections on pileipellis elements.

Pleurocystidia.—Among microscopic characters, pleurocystidia are important. Pleurocystidia are always thick-walled and fusoid-ventricose in section *Pluteus* and easily distinguishable from cheilocystidia (see below). However, they vary in the presence or absence of apical ornamentation. Apical horns are present in those cystidia referred to as the *cervinus*-type (e.g., in *P. cervinus* and its related forms, see Fig. 4, etc.) and absent in those referred to as the *magnus*-type (e.g., in *P. magnus* and its related forms, see Fig. 9, etc.). For evaluation, pleurocystidia near the edge of the lamellae should be observed because in a few taxa, both types of pleurocystidia occur near the lamellar edge.

Cheilocystidia.—Cheilocystidia are always thin-walled in *Pluteus*. The presence or absence of brown homogeneous contents makes the lamellae appear marginate or non-marginate. The shape of cheilocystidia is another important character. In section *Pluteus*, shape varies from the common sphaeropedunculate form (Fig. 1) to more rarely found cylindrical or fusoid-ventricose form (Fig. 17). Dimorphic types are also observed in some cases.

Basidiospore shape and size.—In section *Pluteus*, most basidiospores are ovoid-elliptic with a moderately thick wall (Fig. 4). However, in some taxa, they are globose to subglobose (Fig. 19), while in some others, they exhibit shape dimorphism (Fig. 10). Mature basidiospores are moderate sized (5–8 μm long in profile view). Yet, taxa like *P. salicinus* have larger spores (>8 μm long). Size dimorphism of mature basidiospores is observed in a few taxa. Basidiospore fragility and presence or absence of a conspicuous hilar appendix are two other useful taxonomic features in section *Pluteus*.

Other features.—Additional useful characters include projections on cheilocystidia, presence or absence of pilocystidia, caulocystidia, and mycelium that remains persistently attached to the stipe base.

Phylogenetic Analyses.—Phylogenetic analyses were conducted using PAUP-Macintosh version (PAUP 3.0r; Swofford, 1991). Sixty-three morphological or anatomical characters and character states that were employed are listed in Table I. A binary (0-1 type) matrix was created for these characters (Table II).

Out of 63 obtained characters, 57 varied in two or more taxa and were therefore phylogenetically informative. An heuristic search was performed and only the informative characters were used in the search.

Three series of analyses were undertaken: (1) All characters were equally weighted and standard ancestry was applied (with the use of the outgroup comparison method) to avoid possible bias toward making a given character less or more important for the analyses. Four outgroup taxa were used: *Pluteus admirabilis* (Peck) Peck from section *Celluloderma*, *Volvariella diplasia* (Berk. et Br.) Sing., both of Pluteaceae; *Amanita gemmata* (Fr.) Gill., Amanitaceae, and *Nolanea cystomarginata* Larg., Entolomataceae. Data for outgroups were obtained from Banerjee and Sundberg (1993b); Banerjee (pers. obs.), and Singer (1986); Began (1988); and Largent (1974), respectively; (2) Seven out of the 57 informative characters were given a weight of 8:1 (see Table I) and mixed ancestry for these seven characters was applied, where polarity was hypothesized based on observations and available literature (e.g., Homola, 1975; Smith, 1971; Vellinga in Bas et al., 1990). The same four outgroup taxa were included in the analyses. Finally, (3) A strict consensus tree was obtained using the same parameters as in (1).

One hundred bootstrap replications for each set of parameters with maxtrees set at 100 were performed to test how well-supported the various nodes (relationships) were on a tree.

Multiple most parsimonious trees were obtained in each of the analyses. Out of these trees, in the first two cases, fifty percent majority-rule consensus topology trees were constructed which PAUP mapped characters onto to produce "phylograms". However, these were not true phylograms, because the parsimonious trees used to build the consensus topology all differed in the lengths of their own internal branches, and the topology trees did not depict branch lengths proportional to the number of inferred change of characters. These "phylograms" (topologies) were typically longer than the most parsimonious trees (Vilgalys, pers. comm.).

The strict consensus tree was obtained to show the most conservative relationships among the taxa. Concordant relationships were examined

among the three types of analyses.

Polarization of characters.—The reconstruction of phylogeny by cladistic methods depends upon the determination of evolutionary polarity of character states (Crisci and Stuessy, 1980). These authors mentioned nine criteria (fossil evidence, common is primitive, co-occurrence of primitive states, earliest ontogenetic state, minor abnormalities of organogenesis, vestigial organs, association, correlation, and group trends) by which primitive states of characters could be determined.

To approximate phylogeny in section *Pluteus*, the following seven characters were given extra weight: (1) pileus size, (2) pileus disc color, (3) marginate vs. non-marginate lamellae, (4) degree of wall thickness of pleurocystidia, (5) presence/absence of apical projections on pleurocystidia, (6) type of pileipellis, and (7) presence/absence of clamp connections in the pileipellis.

Using the argument that the most common color and size are ancestral and the unusual and rare are derived, the dark-colored pileus with large size states were considered plesiomorphic (Homola, 1975; Vellinga in Bas et al., 1990).

Pleurocystidia with thick walls and presence of apical projections were considered derived characters applying Crisci and Stuessy's (1980) criterion that the earliest ontogenetic state is plesiomorphic. In *Pluteus*, all pleurocystidial types have thin walls and lack projections in their early ontogenetic state (Strack and Sundberg, 1981; Bonnard, 1988).

The presence of clamp connections was used as a plesiomorphic character state based on the observation that section *Pluteus*, considered primitive in the genus (Smith, 1971; Homola, 1975), has more clamp connections than the presumptive advanced sections *Hispidoderma* and *Celluloderma* (the latter lacks clamp connections). Crisci and Stuessy's (1980) group trend criterion was applied here. The same criterion was used to polarize the types of pileipellis, here the filamentous type, found in section *Pluteus*, was hypothesized to be a plesiomorphic state (Homola, 1975; Vellinga in Bas et al., 1990).

The co-occurrence of ancestral states criterion was used to polarize the character state of lamellar margination, where marginate lamellae were considered plesiomorphic based on the observation that large pileus and/or clamped pileipellis, two other primitive states, always associate with species with marginate lamellae.

TABLE I

MORPHOLOGICAL AND ANATOMICAL CHARACTERS¹ WITH
HYPOTHESIZED POLARITY FOR SECTION *PLUTEUS* AND OUTGROUP
TAXA USED IN PHYLOGENETIC ANALYSES

Characters	Plesiomorphic state (0)	Apomorphic state (1)
1. Habit	Solitary	Gregarious
2. Substrate	Lignicolous	Soil-inhabiting
3. Pileus size	Large (>3 cm)	Small (<3 cm)
4. Pileus disc	Dark	Light
5. Umbo at disc	Absent	Present
6. Pileus surface	Viscid	Dry
7. Pileus surface	Smooth	Rugose
8. Pileipellis surface	Smooth	DiffRACTed
9. Long pileal striations	Absent	Present
10. Basidiome hygrophany	Absent	Present
11. Blue-green coloration	Absent	Present
12. Odor	Inconspicuous	Conspicuous
13. Taste	Mild	Raphanoid
14. Toxicity	Absent	Present
15. Lamellae attachment	Free	Attached
16. Lamellar shape	Arcuate/plane	Others
17. Lamellar edge	Smooth/entire	Serrate
18. Lamellar margination	Marginate	Concolorous
19. Lamellulae	0-2-tiered	>2-tiered
20. Stipe color	Brown/pallid	Others
21. Stipe surface	Glabrous	Scabrous
22. Stipe shape	Equal/tapered	Enlarged at base
23. Stipe hollowness	Hollow	Solid
24. Stipe fibrils	Absent	Present
25. Persistent stipe-base mycelium	Absent	Present
26. Annulus	Absent	Present
27. Annular texture	Membranous	Non-membranous
28. Annular prominence	Inconspicuous	Conspicuous
29. Volva	Absent	Present
30. Volval texture	Membranous	Scaly/wooly
31. Volval prominence	Inconspicuous	Conspicuous
32. Volval margin	Entire	Lobed

TABLE I (Contd.)

Characters	Plesiomorphic state (0)	Apomorphic state (1)
33. Spore print	Pinkish brown	Others
34. Spore size	<7.5 μm	>7.5 μm
35. Spore shape dimorphism	Absent	Present
36. Spore shape	Oval-ellipsoid	Globose/subglobose
37. Spore wall thickness	Thick	Thin
38. Spore wall surface	Smooth	Others
39. Spore angularity	Absent	Present
40. Hilar appendix	Conspicuous	Inconspicuous
41. Basidia	4-sterigmate	4- & 2-sterigmate
42. Pleurocystidia	Absent	Present
43. Pleurocystidial dimorphism	Absent	Present
44. Pleurocystidia	Thin-walled	Thick-walled
45. Pleurocystidial hooks	Absent	Present
46. Pleurocystidial pigments	Absent	Present
47. Cheilocystidia	Absent	Present
48. Cheilocystidial dimorphism	Absent	Present
49. Cheilocystidial shape	Sphaeropedunculate	Cylindrical
50. Cheilocystidial projections	Absent	Present
51. Cheilocystidial pigment	Present	Absent
52. Cystidial mucilage cap	Absent	Present
53. Gill trama	Convergent	Divergent
54. Binding hyphae in trama	Absent	Present
55. Chlamydospores	Absent	Present
56. Pileipellis	Filamentous	Cellular
57. Pileipellis pigment	Absent	Present
58. Pilocystidia	Absent	Present
59. Special cuticular hyphae	Absent	Present
60. Cuticular gelatin matrix	Absent	Present
61. Cuticular mucilage on individual elements	Absent	Present
62. Clamp connections	Present	Absent
63. Caulocystidia	Absent	Present

¹Characters in boldface (3, 4, 18, 44, 45, 56, and 62) denote those with designated polarity where mixed ancestral states and extra weightedness were used for phylogenetic analyses. For other characters and in other types of analyses, standard ancestry was used.

RESULTS AND DISCUSSION

Key to sections of *Pluteus*.

- A. Pileipellis a palisadoderm of sphaeropedunculate cells
Section *Celluloderma* (not treated)
- A. Pileipellis a trichoderm of filamentous hyphae with allantoid or cylindric-fusoid end cells
 - B. Pleurocystidia metuloid Section *Pluteus* (see below)
 - B. Pleurocystidia thin-walled, sometimes collapsing
Section *Hispidoderma* (not treated)

Key to Species of Section *Pluteus*.

- 1. Clamp connections present on pileipellis hyphae 2
- 1. Clamp connections absent on pileipellis hyphae 7
 - 2. Lamellar margins dark 3
 - 2. Lamellar margins concolorous 5
- 3. Pileus small (<1.5 cm broad), brown; lamellar edges grayish near pileus margin only, basidiospores small (<7 μ m long) *P. laricinus*
- 3. Pileus large (>4 cm broad), blackish; lamellar edges blackish brown, basidiospores large (>7 μ m long) 4
 - 4. Pleurocystidia with 2-5 apical projections; basidiospores ovoid-elliptic to lacrymoid (=drop-shaped) *P. atromarginatus*
 - 4. Pleurocystidia without apical projections; basidiospores dimorphic (ellipsoid-ovoid varying to globose) *P. atropungens*
- 5. Basidiome (particularly stipe base) with bluish or grayish green stains with age *P. salicinus*
- 5. Basidiome color unchanging with age 6
 - 6. Terminal elements of pileipellis hyphae versiform *P. washingtonensis*
 - 6. Terminal elements of pileipellis hyphae narrow with rounded ends *P. brunneidiscus*
- 7. Basidiospores monomorphic (ellipsoid-ovoid only) 8
- 7. Basidiospores dimorphic (ellipsoid-ovoid and globose) 17
 - 8. Pleurocystidia near lamellar edge mostly of *magnus*-type (without apical projections) 9

8. Pleurocystidia near lamellar edge mostly of
 cervinus-type (with apical projections) 12
9. Pileus white 10
9. Pileus brown to gray brown 11
 10. Pileus surface glabrous; disc with
 cinnamon-colored fibrils; injured and bruised
 places along pileus margin turning gray *P. cinerascens*
 10. Pileus surface with conspicuous dark squamules;
 injured and bruised place along pileus margin
 not appreciably changing color *P. patricius*
11. Pileus brown to gray-brown; disc and surface
 fibrillose *P. magnus*
11. Pileus brown; disc squamulose *P. atricapillus*
 12. Pileus entirely white *P. pellitus*
 12. Pileus not entirely white,
 at least brown on disc 13
13. Pleurocystidia dimorphic, mostly *cervinus*-type with
 truncated apices and short ornamentations, but
 some *magnus*-type with rounded apices *P. heterocystis*¹
13. Pleurocystidia predominantly monomorphic 14
 14. Pleurocystidia with versiform projections
 (i.e., with horizontal and recurved type) *P. harrisii*¹
 14. Pleurocystidia without versiform projections
 (i.e., with only horn type) 15
15. Cheilocystidia fusoid-ventricose to ampullaceous *P. australis*¹
15. Cheilocystidia predominantly sphaeropedunculate 16
 16. Pileus brown; cheilocystidia
 always monomorphic *P. cervinus*
 16. Pileus white; cheilocystidia
 sometimes dimorphic *P. petasatus*
17. Cheilocystidia monomorphic, pleurocystidia
 dimorphic *P. major*
17. Cheilocystidia and pleurocystidia both dimorphic *P. exilis*¹

¹Extralimital to the study area

Pluteus section *Pluteus* in the Midwest.—

Pluteus atricapillus (Batsch) Fayod, Ann. Sci. Nat., Bot. sér. VII,
9: 364. 1889. **Fig. 1.**
= *Pluteus atricapillus* Sing. & Clem., Nova Hedwigia 23:
332-336, 1972 (1973).

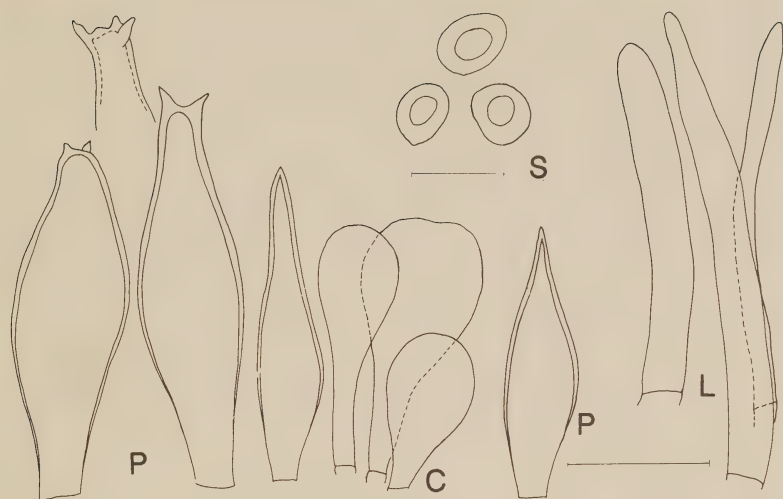
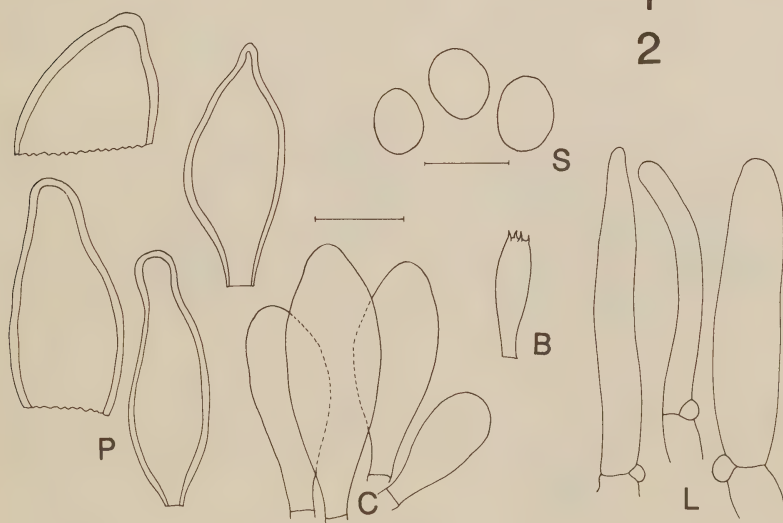
Diagnostic characters: *Pileus* disc with brown squamules, *pleurocystidia* *cervinus*-type, *pileipellis* without clamp connections, *basidiome* with strong raphanoid odor.

Description: *Pileus* 3.5-7.2 cm broad; convex, applanate with an obtuse umbo, occasionally slightly depressed around the umbo, disc brown-squamulose, occasionally slightly uneven or scrobiculate to reticulate-venose; margin slightly or not striate, glabrous and naked, slightly viscid; "sepia" (R) to "fuscous" (R) or pale grayish fuscous, slightly darker at the disc; context pale white, unchanging; odor strongly raphanoid or "slightly mawkish" (Smith, unpublished), taste mild. Lamellae close, arcuate, white when young, pink when mature, edge concolorous and smooth; lamellulae 1-2-tiered. Stipe 4-8.5(-10.8) x 0.7-1 cm, white, subequal or tapering upwards, occasionally bulbous below, glabrous in the upper part, slightly (to occasionally densely) appressed fibrillose, fibrils "fuscous" (R) or "bister" (R), mostly in the lower part, rarely fibrillose all over, solid; basal mycelium white and scanty. Spore mass dirty pink.

Basidiospores 7-7.4(-9.4) x 4.8-5.6(-6) μm , oval-ellipsoid, rarely short-cylindric; hilar appendix inconspicuous; wall moderately thin, few collapsing. Basidia four-spored, occasionally two-spored, 22-30 x 7.4-9 μm . Pleurocystidia numerous, fusoid-ventricose with gradually tapering apices or less commonly ampullaceous, 45-68 x 14-18(-22) μm , wall uniformly 1.6-2.2 μm thick, apices provided with 2-4 suberect or recurved, acute or obtuse horns, some *magnus*-type fusoid and acute (5-65[-105] x 10-15 μm) pleurocystidia found near the lamellar edge, with thinner wall (1-1.2 μm), some pleurocystidia with cytoplasmic content. Cheilocystidia not abundant, 28-50 x (12-)16-20(-24) μm , sphaeropedunculate, all hyaline. Pileipellis a trichoderm of elongate hyphae, in bunches of erect-suberect hyphae forming squamules on the disc, terminal elements 48-120(-155) x 4-6(-12) μm , ventricose, cylindrical or clavate, apex rounded, subacute to rarely acute; thin -walled; with pale "fuscous" (R) to fuscous pigment; clamp connections absent on pileipellis hyphae.

Habit, habitat, and distribution: Solitary or scattered (rarely gregarious) on trunks and logs of hardwood trees (including *Fagus*). June to October. Not often collected in the midwest.

Figs. 1 & 2. Characters of *Pluteus*. 1. *P. atricapillus*; 2. *P. atropungens*. P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, B—Basidia, S—Basidiospores. Scale lines: 10 μm for basidiospores, 20 μm for other anatomical structures.

1
2

Collections examined: From study area: KY: Banerjee 59115, Land Between the Lakes (SIU); MO: Banerjee 812913, Roadside woods, Cape Girardeau (SIU). **Extralimital:** USA—NC: Methven 3890, Yellow Mountain, Macon Co. (EIU); Austria: Singer C 10012, Wien, Lainzer Tiergarten (F); The Netherlands: Singer C 3098, Leeros (F); Switzerland: Singer F 1016872 (topotype, F).

Commentary: The type is not available and probably destroyed. This species is probably an evolutionary intermediate between *P. cervinus* (Schaeff.: Fr.) Kumm. and *P. patricius* (Fr.) Gill. because of its *cervinus*-type pleurocystidia and the disc squamules. It also has some superficial resemblance to *P. exilis* Sing., but the latter has dimorphic cheilocystidia.

Pluteus atromarginatus (Sing.) Kühn., Bull. Trimest. Soc. Linn.
Lyon 4: 51. 1935. **Fig. 3.**

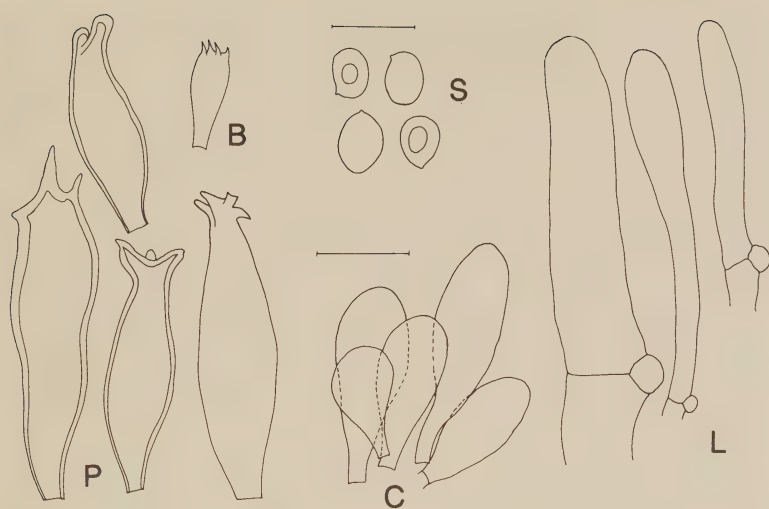
≡ *P. cervinus* var. *atromarginatus* Sing., Z. Pilzk. 4: 40. 1925.

≡ *P. cervinus* subsp. *atromarginatus* (Sing.) Konr., Bull. Trimest. Soc. Mycol. Fr. 43: 148. 1927.

Diagnostic characters: *Pileus large and very dark, lamellar edges fuscous, basidiospores oval-subelliptic, clamp connections on pileipellis hyphae profuse, most pleurocystidia with 2-5 apical or subapical horns, horns sometimes forked. Usually found on conifer wood.*

Description: Pileus 4-12 cm broad, obtuse to convex when young, expanding to plane or with a low and broad umbo; margin often somewhat rimose; surface moist, not hygrophanous, "benzo brown" (R), "mummy brown" (R) to black, at times radially streaked with blackish fibrils on a "drab" (R) ground color, sometimes with minute appressed squamules; context white, thick, cottony and soft; "odor sweetish or fungoid; taste not unpleasant, fungoid" (Singer, 1956). Lamellae close, broad (up to 9 mm), plane-arcuate, white becoming dull "pink" (NBS) to "pinkish buff" (R), margin dark brown to blackish brown ($\pm$ like color of the pileus); lamellulae 1-2-tiered. Stipe 5-12 cm long, 0.5-1 cm broad at apex; somewhat flat, equal to evenly enlarged downward; surface off-white overlaid with dark brown fibrils, not darkening in age; solid, white within. Spore pinkish brown in mass.

Fig. 3. Characters of *Pluteus*. 3. *P. atromarginatus*. F—Fruiting body (basidiome), P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, B—Basidia, S—Basidiospores. Scale lines: 10 μ m for basidiospores, 20 μ m for other anatomical structures.



Basidiospores 6-7.8(-9) x 4.4-5.6 μm , oval-subelliptic to lacrymoid, nearly hyaline, thin-walled, smooth, content granular, hilar appendix conspicuous; basidia four-spored, (17-)28-35 x 7-8.2 μm , hyaline. Pleurocystidia very abundant, 50-85(-105) x 12-20(-27) μm , fusoid-ventricose, hyaline, thick-walled, with 2-5 apical or subapical horns, horns sometimes forked, some pleurocystidia with fewer or no horns are occasionally found. Cheilocystidia in fascicles, (22-)35-58(-80) x 10-20 (-27) μm , clavate to balloon-shaped, with dark brown content, all thin-walled, some hyaline elements are also found intermixed with the colored elements. Pileipellis of narrow (3-6 μm wide) septate hyphae and occasionally of some broader (10-25 μm wide) interwoven hyphae, both with dark brown content; clamp connections profuse on pileipellis hyphae.

Habit, habitat, and distribution: Solitary on conifer logs and debris, rarely reported from soil and deciduous woods. June to October. Uncommon in the midwest.

Collections examined: From study area: MI: Harper 3888, Tahquamenon (MICH). **Extralimital:** USA—ID: Smith 53974, Priest Lake (MICH); NY: Halling 6551 (NY); OR: Sundberg 3657 (SIU); TN: TN 18844, University of Tennessee, Knoxville (TENN); WA: Stuntz 520, University of Washington, Seattle (WTU); Stuntz 9513 (WTU); Austria: Singer C 2023, Steinfield-b-W-Neustedt (F); CSSR-Slovakia: Singer C 5125, Chrudim (F).

Commentary: According to Singer (1956), the type has been destroyed. Although Singer (1956) emphasized only brown cheilocystidia, it is not unusual to find many clavate hyaline elements. Smith (unpublished) considered it significant that the hyaline cheilocystidia sometimes exhibit a thickening of the apical wall creating a cap-like appearance. He believed that variation in the cystidia on the gill edge should also be emphasized. This species is typically found on conifer logs, however, one specimen (Stuntz 9513) has been reported from *Populus* log, and another (Halling 6551) from an unidentified hardwood log.

Pluteus atropungens A. H. Smith and Bartelli, Michigan Bot. 4:61. 1965. **Fig. 2.**

Diagnostic characters: *Lamellae marginate; pleurocystidia irregularly thick-walled, round-ended and unhooked; pileipellis hyphae with clamp connections.*

Description: Pileus 4-10 cm broad; convex to obtusely umbonate; surface dry and scabrous near and over the disc, elsewhere appressed fibrillose,

becoming diffracted exposing the pale context; blackish to "mummy brown" (R) overall until the pileipellis disrupts; flesh pale dingy "buff" (NBS), darker near the pileipellis and just above the lamellae, "rather punk in texture" (Smith and Bartelli, 1965); odor of crushed context strongly pungent, taste very disagreeable. Lamellae somewhat remote, close, broad, plane to arcuate, faces gray to dingy pallid when young, "vinaceous" (R) to "vinaceous buff" (RBG) in age, edges blackish brown. Stipe 6-10 cm long, 1-2 cm thick at apex; equal; surface dull and unpolished to scabrous, colored like the pileus overall, or paler near the apex; solid, dingy buff within, becoming pallid when dry. Basidiospores pinkish brown in mass.

Basidiospores $7.2\text{--}8.2 \times 5.2\text{--}5.4 \mu\text{m}$, oval-elliptical, varying to globose and $6.6\text{--}7 \mu\text{m}$ in diameter, rarely finely angular, moderately thin, hilar appendix not prominent. Basidia 4-sterigmate, $20\text{--}28 \times 7\text{--}8 \mu\text{m}$. Pleurocystidia abundant, $50\text{--}80 \times 10\text{--}20\text{--}(30) \mu\text{m}$, variously shaped; fusoid-ventricose to ampullaceous with hyaline walls gradually thickened toward the apex, apex rounded to occasionally truncate, smooth to rarely irregularly ornamented. Cheilocystidia $38\text{--}68 \times 12\text{--}20 \mu\text{m}$; clavate to fusoid-ventricose, apices broadly rounded to obtuse; smooth; walls thin; content yellow-brown. Pileipellis of filamentous hyphae with yellow-brown content; terminal cells tapered to obtuse at apex, $80\text{--}200 \times 3\text{--}12 \mu\text{m}$; clamp connections readily observed on pileipellis hyphae.

Habit, habitat, and distribution: Gregarious on sawdust, Marquette, Michigan. October 20, 1959. Known only from the type.

Collection examined: MI: Smith 62033 (Holotype, MICH).

Commentary: The morphological description is taken from the protologue (Smith and Bartelli, 1965). *P. atropungens* differs from *P. atromarginatus* by its irregularly thick-walled, round-ended, and *magnus*-type (unhooked) pleurocystidia, and dimorphic basidiospores. *P. atropungens* has a distinctive odor and taste while *P. atromarginatus* is mild. Also, their habitats are different—*P. atropungens* is found on sawdust and *P. atromarginatus* on dead and decaying logs (mostly conifers).

Pluteus brunneidiscus Murr., N. Amer. Fl. 10: 131. 1917.

Fig. 5.

Diagnostic characters: Pileus surface smooth, pinkish-fawn; disc dark brown; pileipellis hyphae with clamp connections.

Description: Pileus 3.5-5.2 cm broad; convex becoming plano-convex, not

umbonate; margin entire, pallid, slightly translucent-striate; surface glabrous, viscid; "fuscous" (R) to "Saccardo's umber" (R) on the disc, "fawn" (K&W) elsewhere. Odor mildly raphanoid, taste mild. Lamellae "vinaceous buff" (RBG), close, arcuate, broad, margins concolorous; lamellulae 1-2-tiered. Stipe 3.5-4.5 x 0.3-0.4 cm, equal to subequal, glabrous, white, hollow with a thick rind, mycelium at stipe base absent. Spore print yellowish pink.

Basidiospores 6-6.8 x 4-5.6 μm , oval-ellipsoid to broadly elliptical to elliptical, wall smooth, moderately thick, content granular, hilar appendix mostly conspicuous. Basidia four-spored, 20-32 x 6.8-8(-10) μm . Pleurocystidia abundant, 35-78(-90) x 12-18(-22) μm ; fusoid-ventricose, with 2-4 short to moderately long (2.4-5 μm long) apical hooks, longer hooks horn-like; walls moderately thick (1.2-1.6 μm), some collapsed at the thinner base; hyaline. Cheilocystidia infrequent, 25-30 x 8-12 μm , broadly clavate; walls smooth, thin; hyaline. Pileipellis of upright-semierect hyphae with rounded ends, some with brown pigment; hyaline, clavate pilocystidia also present but rare, 25-30 μm wide; clamp connections present on pileipellis hyphae.

Habit, habitat, and distribution: Solitary to scattered on mossy hardwood logs. Not very common in the midwest.

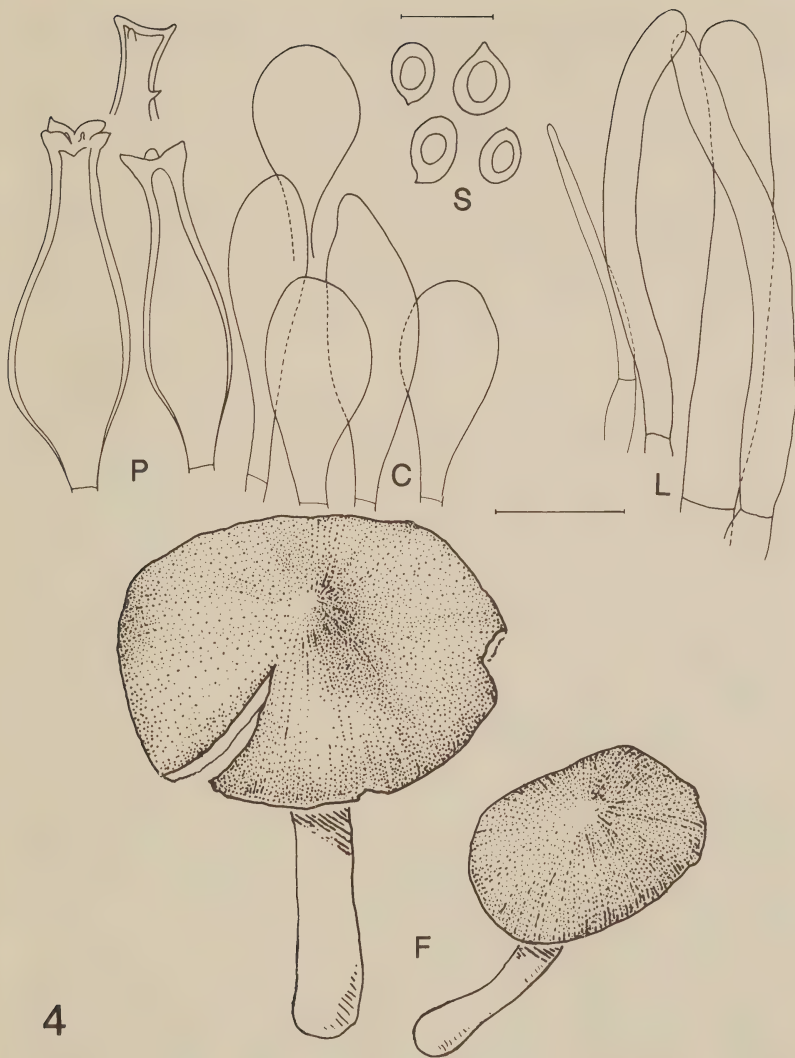
Collections examined: From study area: NY: Earle 524 (Holotype, NY); KY: Banerjee 105902, Land Between the Lakes (SIU); IL: Banerjee 5919, Heron Pond, Union Co. (SIU). **Extralimital:** WA: Stuntz 9948, Hermit Bog (WTU).

Commentary: We were able to locate only a few poorly-preserved clamp connections in the pileipellis. However, clamp connections were easily observed in fresh specimens. Data on odor and taste, lacking for the type, are important to determine the affinity of this species. In fresh specimens, the odor was mildly raphanoid, and the taste was mild. This taxon has affinity with *P. washingtonensis* and/or the *P. salicinus* complex (see discussions on these species).

Pluteus cervinus (Schaeff.: Fr.) Kumm. Führ. in die Pilzk.:99. 1871.

Fig. 4.

Fig. 4. Characters of *Pluteus*. 4. *P. cervinus*. F—Fruiting body (basidiome), P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 μm for basidiospores, 20 μm for other anatomical structures.



- ≡ *Agaricus cervinus* Schaeff., Fung. Bavariae 4: 6. 1774.
 ≡ *A. cervinus* Schaeff.: Fr., Syst. Mycol. 1: 199. 1821.
 ≡ *A. pluteus* Batsch: Fr., Syst. Mycol. 1: 199. 1821.
 = *Pluteus curtisii* Sing., Trans. Br. Mycol. Soc. 39: 160. 1956.
 = *P. laeianus* Sing., Trans. Br. Mycol. Soc. 39: 160. 1956.

Diagnostic characters: *Pileus* medium-sized to large, glabrous and viscid, mostly some shade of light brown; *stipe* surface dingy whitish and glabrescent, and typically with fine pinkish gray-brown, longitudinal, spiral striations; *pleurocystidia* fusoid-ventricose with 2-4 apical hooks; *pileipellis* hyphae without clamp connections.

Description: *Pileus* (3-)5-15(-20) cm broad; obtuse when young, soon broadly campanulate, finally plane or nearly so, sometimes retaining a low broad umbo; margin even to occasionally striate; surface often uneven or wrinkled at first but becoming even in age; glabrous to radially streaked with appressed fibrils, minutely squamulose to fibrillose scale over disc at times, soft to the touch and semiviscid to viscid (rarely very viscid); color variable: "isabella" (R), pale buffy brown, "dresden brown" (R) to "pale smoky gray" (R); disc often darker; *pileipellis* separable to disc; context moderately thick (0.8-1.2 cm) and relatively soft, pallid to white, unchanging; odor mild, taste earth-like to raphanoid (occasionally disagreeable). *Lamellae* approximate to the *stipe*, close; broad (1-1.6 cm); pallid to white before becoming "pink" (NBS) to light pinkish "cinnamon" (K&W), edges even and pallid; *lamellulae* 1-2(-3)-tiered. *Stipe* 5-14(-19) cm long, (0.3-)0.6-1.2(-2.4) cm broad at the apex, firm, solid, equal to slightly tapering, pallid, surface dingy whitish and glabrescent, and typically with fine pinkish gray brown spiral striations along the length (occasionally with blackish fibrils forming a reticulum), evenly colored throughout except for the base that sometimes shows traces of fibrils with color similar to disc; *stipe* base sometimes slightly cottony myceloid. Basidiospores "cinnamon" (K&W)-colored in mass.

Basidiospores 5.4-8(-10) x (4-)4.4-5.4(-6.4) μm ; narrowly oval to broadly ellipsoid to subglobose; smooth, wall slightly thickened, nearly hyaline; hilar appendix conspicuous. Basidia four-spored; (17-)22-25(-38) x 6-7(-9.6) μm ; content granular when fresh. *Pleurocystidia* numerous; 54-90(-124) x 10-22(-31) μm ; fusoid-ventricose, apices studded with (0-1)2-4 (-7) horn-like projections; wall thickened in upper half (1.8-2.6 μm thick

at neck); hyaline. Cheilocystidia in fascicles; (15-)38-66(-75) x (7-)9-15 (-27) μm ; clavate to sphaeropedunculate to occasionally broadly fusoid, rarely (only one collection) with a mucronate tip; smooth, thin-walled; hyaline. Pileipellis of narrow appressed hyphae with rounded ends; (45-)60-110 x 4-7(-20) μm in diameter, rarely (only one collection) the end cell becoming very narrow (1-2 μm wide) with an acute apex; nearly hyaline to dingy brown in some cells, occasionally subgelatinous as revived in KOH; rarely some pale "fuscous" (R) cylindric pilocystidia (140-175 x 10-18 μm) intermixed; clamp connections absent on pileipellis hyphae.

Habit, habitat, and distribution: Solitary to scattered (to gregarious) on decayed hardwood logs, stumps and sawdust, but also reported from conifer duff, and at least in one case from an *Abies* log (IS 208). Very common in the midwest, and of worldwide occurrence. March to October (occasionally up to November).

Collections examined: From study area: IL: Banerjee 910911, Ferne Clyff, Banerjee 910914, Ferne Clyff, Banerjee 4914, Evergreen woods, Carbondale, Jackson Co., Banerjee 59110, Pyramid State Park, Perry Co. (all at SIU); Methven s.n., Sand Ridge State Forest, Mason Co., Methven 6252, Alice Kibby Life Science Station, Warsaw, Hamilton Co., Methven 5551, Foley's Woods, Hwy 16, Edgar Co., Methven 6380, Beall Woods, Wabash Co. (all at EIU); Monoson 360, Peoria Co. (Bradley University); KY: Banerjee 812916, Land Between the Lakes (SIU); MI: Smith 56267, Trueblood 214 (both at MICH). **Extralimital:** USA—MA: Bigelow 18675, Conway (NY); OH: F 037659, F 038318, F 036786, F 17424 (all at MU); OR: IS 208 (WTU); TN: TN 20807, Knox Co. (TENN); UT: Rogerson s.n., Beaver Co. (NY); WA: SLB 383, Watermain Woods, Redmond (WTU); WI: Stuntz 1271, University of Wisconsin (WTU); Canada—Ontario: Zurba 56, Algonquin Park, Ontario (MICH).

Commentary: This is probably the most widely known species in the genus. *P. cervinus* is the type species not only of the section *Pluteus*, but also of the genus *Pluteus* and the family Pluteaceae. However, a type specimen does not exist. As such, neotypification of *P. cervinus* is absolutely necessary from specimens collected from the type locality in Europe. *P. cervinus* sensu lato is probably a complex of several good biological species, or at least an assemblage of several different varieties and forms. The lack of type material makes the situation even more complicated as there is no way to accurately circumscribe the species based on a comparison with the type. Molecular data and phylogenetic analyses might be helpful in species circumscription and elucidation of interrelationships. Our knowledge of this species is based on its subspecies or varieties and their types. We examined the types of *P. curtisii* Sing. (Trans. Br. Mycol. Soc. 39: 160, 1956) and *P. laeianus* Sing. (Trans. Br.

Mycol. Soc. 39: 167, 1956) and could find no significant differences between their characters with those of *P. cervinus*; therefore we synonymized them with *P. cervinus*. Two other collections were examined: one with cheilocystidia with mucronate tips, the other with pileipellis hyphae with very narrow acute apices. These could be taken out from *P. cervinus*, and at least put in new varieties. However, data from more collections are needed before doing this.

Pluteus cervinus* var. *scaber Lange, Fl. Agar. Dan. 2: 83. 1937.

Fig. 7.

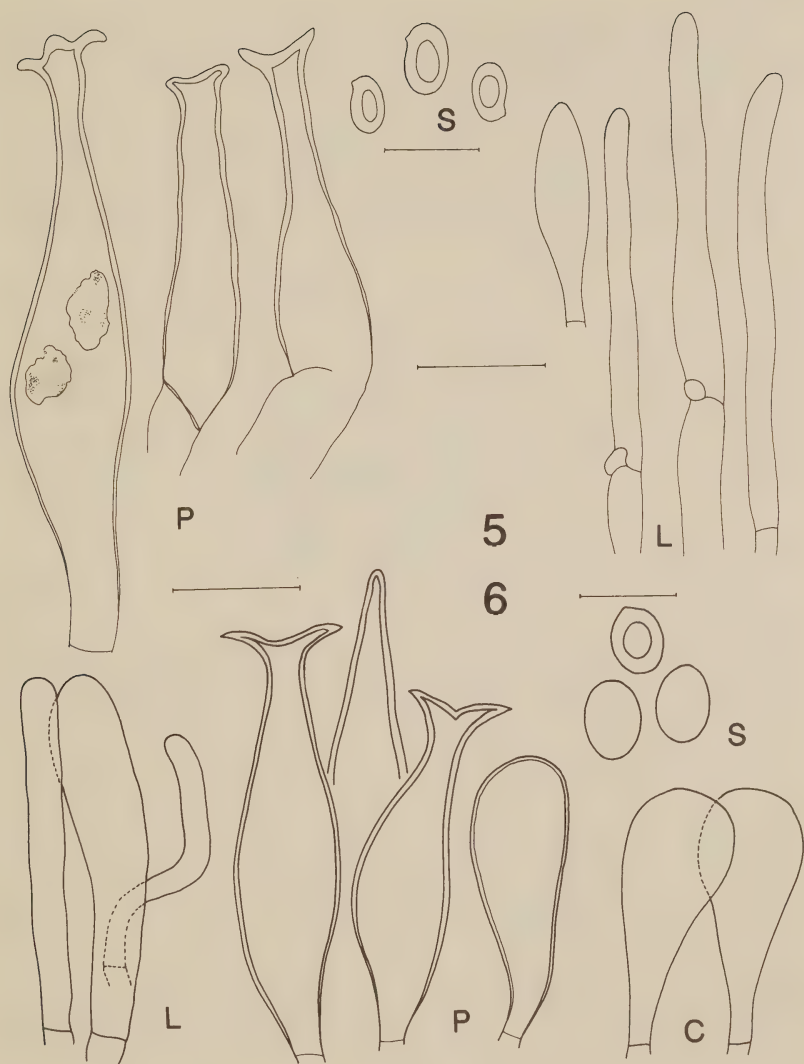
Diagnostic characters: Young pileus blackish, dark cinnamon-brown when mature, disc wrinkled; stipe surface fibrillose-scabrous.

Description: Pileus 5-15 cm broad; obtusely convex, becoming plane retaining a low umbo; surface glabrous and viscid to the touch, wrinkled around the disc; blackish when young, gradually paler to a dark dull "cinnamon" (K&W) brown; context soft and white; odor raphanoid, occasionally none; taste mild to slightly disagreeable. Lamellae broad, close, (almost) approximate to the stipe, edges even and concolorous; lamellulae 1-2-tiered. Stipe 8-15(-18) cm x 1-1.2(-1.5) cm, solid, gradually enlarged downward to equal, "base at times enlarged into an abrupt bulb" (Hesler, unpublished); surface thinly covered with dark gray brown fibrils "with free tips causing surface to be fibrillose-scruffy, this covering extending to apex" (Singer, 1956); occasionally surface stains "yellowish brown" (K&W) upon bruising or handling.

Basidiospores 6-7.4 x 5-5.8 μ m; broadly ellipsoid, hyaline, wall finely thickened, smooth. Basidia four-spored; 22-28 x 6-7.5 μ m. Pleurocystidia abundant; 60-88 x 10-24 μ m; fusoid, hyaline, uniformly thick-walled (2.0-2.2 μ m thick), apex with 2-3(-5) horizontal to recurved simple or rarely compound horns. Cheilocystidia clavate-pedicellate; 30-45 x 6-12 μ m, hyaline, thin-walled, smooth. Pileipellis of radial hyphae 5-10 μ m in diameter, hyaline or pale "bister" (R); clamp connections absent on pileipellis hyphae.

Habit, habitat, and distribution: Solitary to gregarious on hardwood logs, especially on alder. Moderately common to uncommon in the midwest.

Figs. 5 & 6. Characters of *Pluteus*. **5.** *P. brunneidiscus*; **6.** *P. cinerascens*. P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 μ m for basidiospores, 20 μ m for other anatomical structures.



Collections examined: From study area: KY: Banerjee 4912, Land Between the Lakes (SIU). **Extralimital:** CA: Smith 56267, Trinidad (MICH); WA: Smith 39846, Mt. Rainier National Park (MICH), Stuntz 1270, University of Washington (WTU); WI: Stuntz 277, University of Wisconsin (WTU).

Commentary: Blackish color of the young pileus, wrinkled disc, and fibrillose-scabrous stipe surface extending to apex are distinctive characters for this variety of *P. cervinus*. This taxon could be elevated to the rank of species, as suggested by Singer (unpublished). However, more collections should first be examined.

Pluteus cinerascens Banerj. & Sundb., Mycotaxon 47: 389-390. 1993. **Fig. 6.**

Diagnostic characters: Pileus medium-sized (± 7 cm broad) with a white ground color covered with cinnamon-buff fibrils, injured and bruised places along pileus margin slowly become "cinereous"; cervinus-type pleurocystidia with long and sharp apical hooks, pleurocystidia near lamellae edge mostly of magnus-type; clamp connections absent.

Description: See Banerjee and Sundberg (1993a).

Habit, habitat, and distribution: Solitary on rotten logs. Not common in the midwest.

Collections examined: From study area: MI: Smith 57433, Proud Lake, Oakland Co. (Holotype, MICH); IL: Klavins s.n., Giant City State Park, Jackson Co. (SIU).

Commentary: Even though only two basidiomata have been examined, the cinereous stains and the strongly developed hooks clearly distinguish it.

Pluteus laricinus Banerj. & Sundb., Mycotaxon 47: 390. 1993. **Fig. 8.**

Diagnostic characters: Pileus 1.5 cm wide, Saccardo's umber in color, squamulose on the disc; stipe slender; spores small; lamellar margins grayish; most pleurocystidia near lamellae edge are of magnus-type; a few clamp connections on pileipellis hyphae.

Description: See Banerjee and Sundberg, Mycotaxon 47: 390, 1993a.

Habit, habitat, and distribution: Solitary on rotten logs. Not common in

Fig. 7. Characters of *Pluteus*. 7. *P. cervinus* var. *scaber*. F—Fruiting body (basidiome), P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 μ m for basidiospores, 20 μ m for other anatomical structures.



the midwest.

Collection examined: From study area: MI: Smith 38888, Proud Lake Recreation Area, Oakland Co. (Holotype, MICH).

Commentary: Even though only one basidiome has been examined, the small spores, the grayish lamellar margin, and slender stipe distinguish the species.

Pluteus magnus McClatchie, Proc. So. Calif. Acad. Sci. 1: 383. 1897.

Fig. 9.

Diagnostic characters: Large (up to 20 cm broad) basidiomata, brown to gray brown pileus with fibrillose surface; pleurocystidia scattered, typically of the *magnus*-type: fusoid-ventricose, gradually tapering to an acute or rarely forked apex; clamp connections absent on pileipellis hyphae.

Description: Pileus (7-)10-18(-22) cm broad; convex-subumbonate to expanded, eventually becoming irregularly applanate; pale "isabelline-umber" (R) or smoky (pale gray), occasionally dark "fuscous" (R) or almost blackish; surface fibrillose, with or without fuliginous appressed fibrillose squamules on the disc, sometimes faintly innately fibrillose overall; margin subviscid; entire when young, eventually becoming rimose, and occasionally scrobiculate, not conspicuously translucent-striate; context white, unchanging; inodorous; taste mild. Lamellae crowded, 1-"salmon" (K&W); lamellulae 1-2-tiered. Stipe 6-10(-20) cm long, (0.6-)1-1.8(-2.2) cm thick; 2.5 cm broad, white becoming pale equal to subequal; fibrillose, white or brownish from the innate fibrils, sometimes slightly but coarsely longitudinally fibrous-rugose; solid.

Basidiospores (4-)5-7.4(-8.4) x 4.6-5.8(-6.5) μ m; oval-ellipsoid to ellipsoid; smooth, hilar appendix visible; wall moderately thin, hyaline. Basidia 25-28 x 6-10 μ m; four-spored. Pleurocystidia scattered, (45)60-80 x 9-16(-20) μ m; fusoid-ventricose, gradually tapering to an acute apex; ornamentation lacking on pleurocystidia, lateral ornamentation rarely present; wall uniformly 1-1.6 μ m thick; all pleurocystidia hyaline. Cheilocystidia (22-)45-80(-120) x (8-)12-24 μ m; sphaeropedunculate to elongate-clavate; thin-walled, smooth; hyaline. Pileipellis of filamentous hyphae; apices tapered, rounded or subacute, 3-5(-10) μ m in diam; content hyaline to dingy brown, occasionally dark brown in some hyphae (from the dark "fuscous" (R) form); clamp connections absent.

Habit, habitat, and distribution: Solitary or occasionally scattered on decayed hardwood, sometimes found on buried and burned wood. Not

common in the lower midwest of the U.S.

Collections examined: From study area: MI: Smith 57549, Tahquamenon, Smith 57521, Smith 57539, Smith 58041 (all at MICH). **Extralimital:** NC: TN 20848, near Sylva (TENN); WA: Ammirati 9384, SW Everett (WTU).

Commentary: The morphological data on the type are a combination of the original description, information from Singer's (1956) account, and Smith's unpublished notes. Lateral spinules on the pleurocystidia are not at all common in this species.

Pluteus major Sing., Fieldiana, Bot. p. 96. 1989.

Fig. 10.

Diagnostic characters: *Pileus* up to 8 cm broad; *stipe* white; *spores* dimorphic; *pleurocystidia* dimorphic, with strong pointed hooks; *clamp connections* none.

Description: *Pileus* 6.7-8 cm broad; "brownish when dried, with a small umbo"—PB; context white, unchanging; odor slightly raphanoid, mold; taste not recorded. "Lamellae arcuate, close, lamellulae 1-2-tiered"—PB. *Stipe* $\pm$ 6.6 cm long, 0.8-0.9 cm broad, at base 1.2 cm broad; white, slightly white-flocculose and wrinkled in fresh state, little rough when dry.

Basidiospores dimorphic: few globose, 5.6-6.2 μ m diam, most oval-ellipsoid, 7.6-8.2(-9) $\times$ 6-6.4 μ m, with inconspicuous hilar appendix. Basidia 16-18 $\times$ 6-7 μ m, four-spored. Pleurocystidia dimorphic: (1) *magnus*-type more common near lamellar edges, 34-66 $\times$ 12-18 μ m, wall relatively thin, (1-1.2 μ m thick); (2) *cervinus*-type in large numbers on lamellar faces, 35-78 $\times$ 12-18(-22) μ m; wall thicker (1.2-1.6 μ m), apex provided with 2-5 projections, most projections straight and long, up to 6 μ m long, less commonly blunt, short, and bifid; some *cervinus*-type forms with sticky heads with some spores adhering; all pleurocystidia hyaline. Cheilocystidia in fascicles, 25-48(-58) $\times$ 20-32(-40) μ m; most vesiculose-pedicellate, with relatively thin walls (1-1.2 μ m thick); occasional fusoid-ventricose cheilocystidia observed, similar to *magnus*-type pleurocystidia but with much thinner walls; all cheilocystidia smooth, hyaline. Pileipellis a loosely-formed ixotrichoderm (with a scant amorphous gelatinous material) of embedded flexuous repent hyphae with rounded ends; end-cells 4.6-7 μ m wide, some straight hyphae also found scattered in the trichoderm; clamp connections on pileipellis hyphae none.

Habit, habitat, and distribution: More or less gregarious, on decayed

frondose wood ("*Quercus*"?). Not common in the midwest.

Collections examined: From study area: F 1068646, Forest Preserve east of Wheeling (Holotype, F), IL: Singer N 5128, Elk Grove (F).

Commentary: The morphological description and notes on habit and habitat are translated from Singer's description (1989). According to him, "This is a large fungus with $\pm$ umbonate pileus, the umbo covered by erect fibrils, but it has white stipe. Similar forms with strongly scabrous stipe, but the fibrils dark-colored as in *Leccinum scabrum* (Bull.: Fr.) S.F. Gray, occur in Europe and seem to intermediate between *P. major* Sing. and *P. exilis* Sing." However, several differences are observed: (1) metuloids in *P. exilis* are much thicker-walled than those in *P. major*, (2) basidiospores are dimorphic in both species, but in *P. major*, they are globose and ellipsoid-oval as opposed to oval-elliptical and almost cylindrical in *P. exilis*, (3) *P. major* also has a loosely formed ixotrichoderm unlike *P. exilis*. However, the presence of dimorphic pleurocystidia and basidiospores, absence of clamp connections in the pileipellis, and strong pointed hooks at the pleurocystidial apex indicate a relationship between these two species.

Pluteus patricius (Schulz. in Kalchbr.) Boud. in Sacc., Sylloge
Fungorum V. 1944. **Fig. 12.**

$\equiv$ *Agaricus patricius* Schulz. in Kalchbr., Ic. Sel. Hymenomyc.
Hungariae: 20. 1874.

$\equiv$ *Pluteus cervinus* var. *patricius* (Schulz.) Mass., Br. Fung. Fl. 2:
284. 1893.

$\equiv$ *P. patricius* (Schulz.) Boud., Ic. mycol. 1: 87. 1904.

Diagnostic characters: *Pileus* medium-sized to somewhat large (5-12 cm), white or grayish white, usually with very conspicuous appressed dark brown concentric squamules on the disc; stipe white with an innately dark brown fibrillose thickened base; pleurocystidia mostly of magnus-type, wall thin; cheilocystidia cylindric to narrowly clavate; clamp connections absent.

Figs. 8 & 9. Characters of *Pluteus*. 8. *P. laricinus*; 9. *P. magnus*. P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 μ m for basidiospores, 20 μ m for other structures.



Description: Pileus 5-12 cm; convex to applanate, with inrolled margin when young, with a low umbo or shallow depression; white or grayish white, at center pale brown to "ochraceous" (R) yellow; mostly with very conspicuous appressed dark brown concentric squamules, more rarely somewhat smooth and with innate fibrils; subviscid when young; context dull white; odor earth-like, sweet-raphanoid to strongly sweet, rarely of rotten tomato; taste fungoid, sometimes bitter. Lamellae free, close, arcuate; white when young, later "pale pink" (NBS) to pink, margins concolorous and even; lamellulae 1-2-tiered. Stipe (2.5-)6-11(-14) x 0.6-2 cm, cylindrical or tapering upwards; white, with thickened and innately dark brown fibrillose base; solid; basal mycelium absent. Basidiospores rusty pink, pink-brown, or "terra cotta" (K&W) in mass.

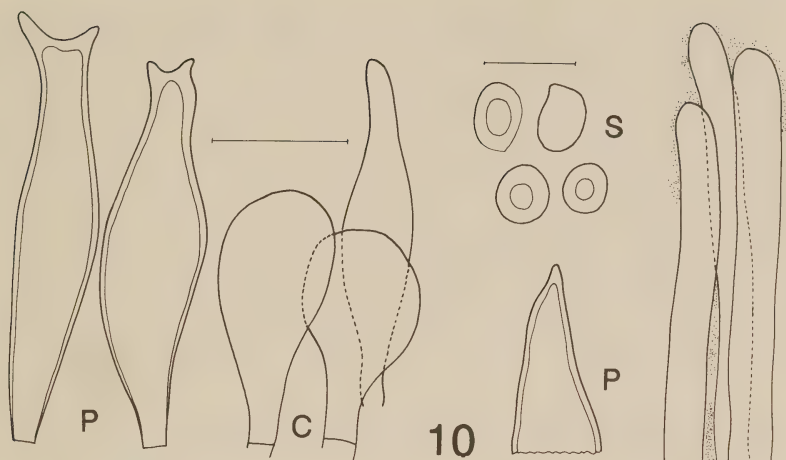
Basidiospores 5.6-7.4(-8.6) x 3.8-5.0(-5.6) μ m; oblong-ellipsoid to oval-ellipsoid; hilar appendix visible. Basidia (15-)20-35 x 5.5-8 μ m; four-spored. Pleurocystidia very abundant; 48-80 x 10-16 μ m; fusoid-ventricose; mostly of *magnus*-type, rarely bifid or with 1-3 hooks at and near apex; wall thin, 1-1.2(-1.6) μ m thick at neck, hence pleurocystidia not rigid and sometimes collapsing at base where wall is thinnest; hyaline. Cheilocystidia in fascicles; (25-)55-68(-75) x 10-12(-16) μ m; cylindric to narrowly clavate, with a broadly rounded apex; thin-walled; hyaline. Pileipellis made of brown, adnate hyphae, and in squamules of erect-suberect hyphae 5-20 μ m wide; all other hyphal end-cells 60-120(-145) x 3-5 μ m, with an obtuse to rounded apex; clamp connections absent.

Habit, habitat, and distribution: Solitary to scattered on decaying sawdust or on stumps of old deciduous trees (*Fagus*, *Populus*, or *Quercus*); moderately common in the midwest.

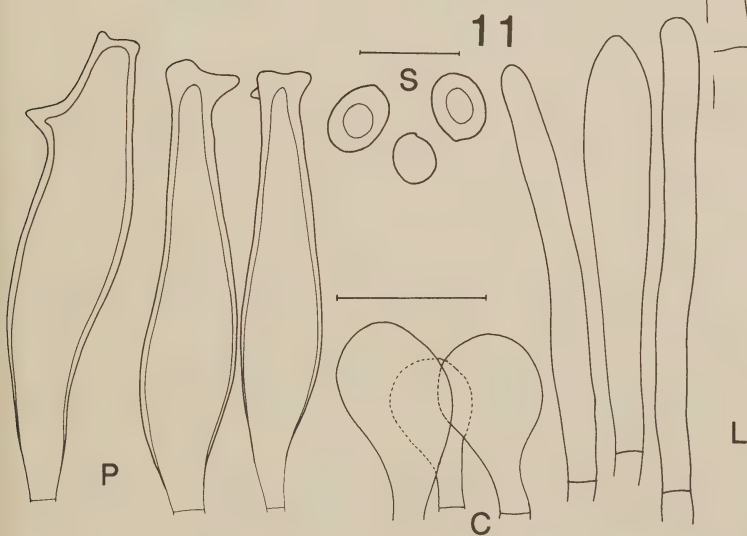
Collections examined: From study area: USA—IL: Banerjee 7911, SIU campus, Carbondale, Jackson Co. (SIU), Methven 5621, Charleston, Coles Co. (EIU); KY: Banerjee 910913, roadside lawn, Paducah (SIU); MI: K.A. Harrison 10325, Marquette Co. (MICH); TN: Banerjee 820916, roadside lawn, Jackson (SIU). **Extralimital:** IN: Yarus s.n., Bloomington (SIU); MA: Burlingham collection, Old Deerfield (NY); TN: Methven 2754, University of Tennessee, Knox Co. (TENN); Canada—Ontario: DAOM 46857, Ottawa, Ontario (DAOM); USSR: Singer 1936 collection (F).

Commentary: "The type consists merely of the picture published by Kalchbrenner in *Icones Selectae Hymen.* I, 20, pleurocystidia 10, fig. 2, 1873" (Singer, 1956). Vellinga (1990) considers *P. patricius* a synonym

Figs. 10 & 11. Characters of *Pluteus*. 10. *P. major*; 11. *P. pellitus*. P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 μ m for basidiospores, 20 μ m for other anatomical structures.



10



11

of *P. petasatus*. Even though these two species have some superficial resemblance and some transitional forms are found between the dark brown-squamulose pileus surface of *P. patricius* and relatively smooth, viscid pileus surface of *P. petasatus*, we concur with Singer (1956) in recognizing them as separate. *P. patricius* and *P. petasatus* are distinguished by the presence of the hooked and thick vs. unhooked and thin pleurocystidia and cylindric-clavate vs. sphaeropedunculate cheilocystidia, respectively. *P. petasatus* is therefore allied with *P. cervinus* and *P. patricius* has affinities to *P. magnus*. *P. petasatus* also sometimes has dimorphic cheilocystidia but those of *P. patricius* are consistently monomorphic. Tissue culture, mating, molecular studies and phylogenetic analyses based on all characters should further clarify this taxonomic problem.

Pluteus pellitus (Pers.: Fr.) Kumm., Führ. in die Pilzk.: 98. 1871.

Fig. 11.

=*Agaricus pellitus* Pers., Syn. meth. Fung.: 366. 1801.

=*Agaricus pellitus* Pers.: Fr., Syst. mycol. 1: 198. 1821, non
Agaricus pellitus Batsch, 1783.

Diagnostic characters: Pileus small to medium-sized (3-5 cm broad), plano-convex to plane when mature, surface glabrous and evenly dull white; stipe white; pleurocystidia *cervinus*-type; pileipellis hyphae without clamp connections.

Description: Pileus 3-5(-8) cm broad; obtuse when young, expanding to convex or plano-umbonate or with a shallow depression; evenly dull white and changing to "yellowish white" (K&W) in age; surface glabrous, somewhat radially fibrillose; moist but not hygrophanous; context white, moderately thick and cottony; odor fungoid; taste mild raphanoid. Lamellae remote from the stipe in age, broad, close to crowded, white, becoming pink, edges slightly fimbriate and whitish; lamellulae 1-2-tiered. Stipe 4-10 x 0.4-0.8 cm; equal or evenly enlarged white throughout and not changing appreciably; naked above but somewhat fibrillose downward, sometimes with a broadened bulbous base; squamose around the base; firm; lacking persistent mycelium at stipe base.

Basidiospores 6.8-7.8(-9) x (4.6-)5.4-6 μ m; broadly ellipsoid to oval-ellipsoid; smooth, few collapsing; wall thin to only slightly thickened; hilar

appendix inconspicuous; hyaline. Basidia 16-22 x 6-7.4(-9) μm ; four-spored, occasionally 2-spored; hyaline. Pleurocystidia very abundant; (34-)55-80(-90) x 9-16 μm ; fusoid-ventricose to broadly cylindrical with an obtuse or occasionally truncated apex; few *magnus*-type; all hyaline; irregularly thick-walled (1.8-2 μm at neck); with 2-5 (mostly 2) short and blunt hooks at or near the apex. Cheilocystidia 28-34 x 8-14 μm ; sphaeropedunculate; rarely some similar to pleurocystidia but with thin walls. Pileipellis of appressed radial hyphae; occasionally with a loosely formed ixotrichoderm; terminal members 50-125 x 4-7.4(-10) μm , apices rounded; hyaline. Clamp connections none on pileipellis hyphae.

Habit, habitat, and distribution: Solitary to scattered on wood of hardwoods. Moderately common in the midwest.

Collections examined: **From study area:** IL: Banerjee 890, Touch of Nature woods, Jackson Co. (SIU); KY: Banerjee 820917, Land Between the Lakes (SIU); MI: Smith 42452, Tahquamenon Falls, Smith 57419, Berry Creek, Cheboygan Co., Smith 57519, Tahquamenon, Thiers 754, Cheboygan Co. (all at MICH). **Extralimital:** OH: F 27988, Hamilton Co. (MU); WA: Stuntz 15827 (WTU), Guravich 921 (WTU); Canada—Ontario: Beardslee Jr. 20156, Ontario (MICH).

Commentary: The type is probably destroyed. No clamp connections were observed in dried American specimens, although they should be present according to Kühner and Romagnesi (1953). However, Singer (1956), Vellinga and Schreurs (1985), and Vellinga in Bas (1990) also did not find any clamp connections in their European collections of *P. pellitus*. In agreement with these authors, we find the spores in *P. pellitus* larger than those noted by Kühner and Romagnesi (1953). It appears that Kühner and Romagnesi's (1953) concept of *P. pellitus* is incorrect.

Pluteus petasatus (Fr.) Gill., Hyménomycètes: 395. 1876.

Fig. 13.

≡ *Agaricus petasatus* Fr., Epicr.: 142. 1838.

≡ *Pluteus petasatus* (Fr.) Sacc., Syll. Fung. V: 668. 1887.

= *P. straminiphilus* Wichansky, Mykol. Sb. 45: 119. 1968.

Diagnostic characters: *Pileus* medium-sized (4-8 cm broad), umbonate, whitish "umber" (RBG), finely radially striate up to the center by innate fibrils, shiny; stipe white, innately brown fibrillose at base; pleurocystidia not numerous, mostly cervinus-type with horned apices, wall 1.6-2.2 μm thick; cheilocystidia in most cases sphaeropedunculate; clamp connections absent.

Description: Pileus 4-8(-12) cm broad; convex to applanate, umbonate; glabrous; pale whitish "umber" (RBG) to occasionally off-white; finely radially striate up to the center by innate fibrils, occasionally breaking up into areolate scales; shiny or subviscid when young, later often dull, sometimes viscid with separable pileipellis; context dull white; odor raphanoid; taste fungoid, sometimes metallic. Lamellae close, arcuate, white when young, later "pale pink" (NBS) to pink, margins concolorous and even; lamellulae 1-2-tiered. Stipe (4.5-)7-11(-14.5) x (0.5-)0.8-1.5 cm, cylindrical or tapering upwards; solid; white, innately brown fibrillose at base; context shiny white.

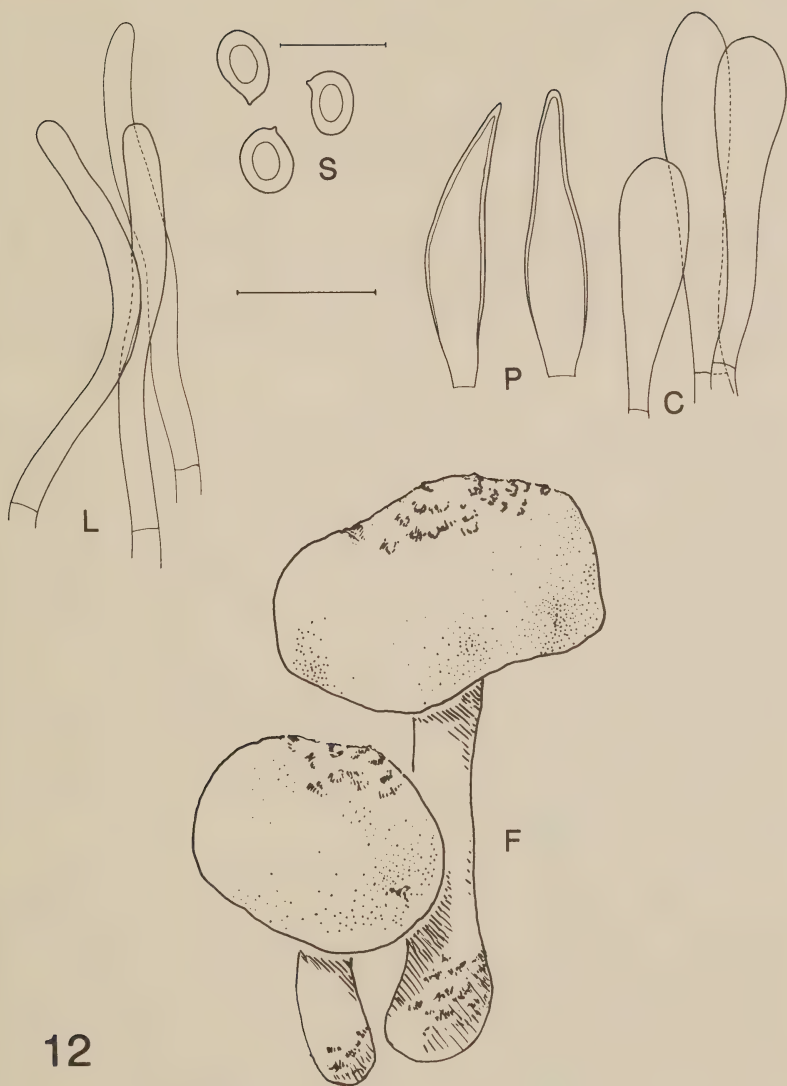
Basidiospores (5.0-)5.6-7.6(-8.4) x 3.8-5.4 μ m; oblong-ellipsoid to broadly ellipsoid; hilar appendix not prominent. Basidia (15-)20-33 x 5-8.4 μ m; four-spored. Pleurocystidia 45-70(-90) x 10-14(-20) μ m; mostly of *cervinus*-type, somewhat narrowly fusoid-ventricose; rigid, wall 1.6-2.2 μ m thick; apex with 2-4(-5) apical prongs, few with additional 1-2 lateral hooks; all pleurocystidia hyaline. Cheilocystidia infrequent; 30-65 x 12-18 μ m; mostly sphaeropedunculate, occasionally some fusoid-ventricose. Pileipellis a trichoderm made up of mostly colorless or rarely brown, elongate repent hyphae with rounded ends, end cells obtuse- to round-ended; clamp connections absent on pileipellis hyphae.

Habit, habitat, and distribution: Solitary to scattered, mostly on soil (usually under *Acer*, *Liquidamber*, *Liriodendron*, or *Quercus*), sometimes on decaying sawdust, or rarely on stumps of old deciduous trees; common in the midwest.

Collections examined: From study area: IL: Banerjee 5921, on ground, Oakland Av., Carbondale, Jackson Co. (SIU), Sundberg 4296, Chataqua Road, Carbondale, Jackson Co. (SIU), Methven 5621, Charleston, Coles Co. (EIU), Borders 31, Big Muddy river, Colp, Williamson Co. (SIU), F 036449, Hall's Ford woods, Coles Co. (F); KY: Banerjee 5917, Land Between the Lakes (SIU); MI: Smith 6770, Pontiac, Oakland Co. (MICH). **Extralimital:** MS: D. Guravich 921, Washington Co. (SIU); NY: Banerjee 7391, on ground, NY Botanic Garden, Bronx (SIU), Halling 4470, Raquette Lake, Long Point near Silver Beach, Hamilton Co. (NY), C.H. Peck (collected on 7.27.04, McLean, NY), Burlingham s.n. (NY); TN: Methven 2772, University of Tennessee, Knox Co. (TENN), Methven 5075, same as before (TENN).

Commentary: The type is not available and probably destroyed. See

Fig. 12. Characters of *Pluteus*. 12. *P. patricius*. F—Fruiting body (basidiome), P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 μ m for basidiospores, 20 μ m for other anatomical structures.



commentary for *P. patricius*.

Pluteus salicinus (Pers.: Fr.) Kumm., Führ. in die Pilzk.: 99. 1871. **Fig. 14.**

= *Agaricus salicinus* Pers., Ic. Desc. Fung.: 9. 1798.

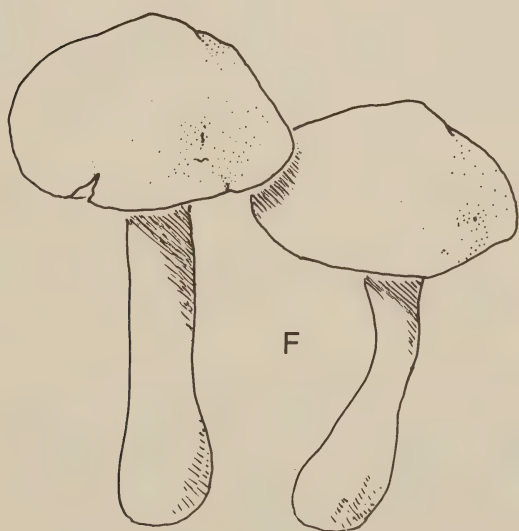
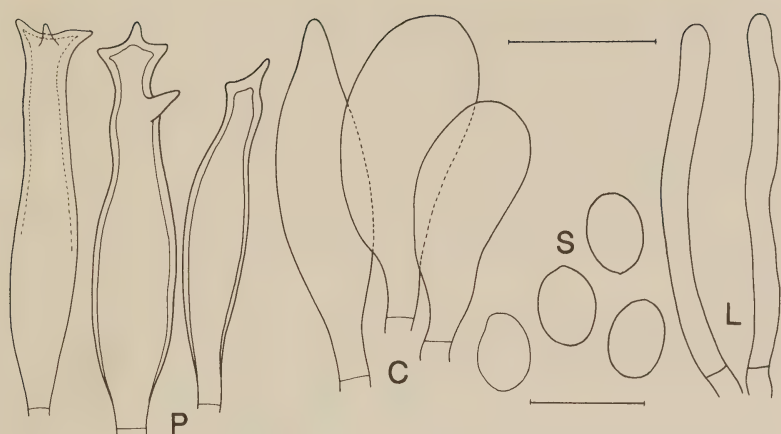
= *A. salicinus* Pers.: Fr., Syst. Mycol. 1: 202. 1821.

Diagnostic characters: *Pileus* small (2-5 cm broad), gray-brown, in age drab or a more bluish gray, surface dry and minutely scabrous over the blackish disc, often with minute appressed squamules toward the margin; stipe developing bluish, bluish gray or bluish green stains over time; pleurocystidia of cervinus type; clamp connections abundant on pileipellis hyphae.

Description: *Pileus* 2-5 cm broad; obtuse to campanulate when young, often becoming and remaining broadly convex to plane, rarely umbonate; margin even, translucent-striate; surface typically dry and minutely scabrous over the disc and often with minute appressed squamules toward the margin; color varying from near gray brown, "Hay's brown" to nearly "fuscous" (R) at first and in age "drab" (R) or a more bluish gray; not hygrophanous; context thin, dingy, gray to watery; odor mild to rarely disagreeable (acid-like); "taste reminding one of that of *Clitocybe nebularis*" (Smith, unpublished). Lamellae free and fairly remote from the stipe; close, moderately broad; whitish when young, "pink" (NBS) in age; edges smooth to fimbriate; concolorous; lamellulae 1-2-tiered. Stipe 2.5-7 cm long, 3-4(-7) cm thick at apex; equal or nearly so; whitish overall at first but developing bluish, bluish gray or bluish green stains over lower part or at base; glabrous; hollow, somewhat fragile; scant persistent mycelium at stipe-base.

Basidiospores 7-8.4(-10) x 5-6 µm; ellipsoid to ovoid; smooth, nearly hyaline. Basidia 30-35 x 7-8 µm; four-spored; hilar appendix conspicuous; hyaline and with content granular in KOH. Pleurocystidia very abundant, occasionally infrequent; (40-)-50-70(-88) x (11-)-15-18 µm; fusoid-ventricose with a crown of 3-5 acute or obtuse and uniformly to irregularly arranged horns around the apex; the distal wall (from ventricose

Fig. 13. Characters of *Pluteus*. 13. *P. petasatus*. F—Fruiting body (basidiome), P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 µm for basidiospores, 20 µm for other anatomical structures.



portion to tip) apparently quite rigid but not very thick (1.2-1.4 μm thick). Cheilocystidia in fascicles; (20-)35-50(-85) $\times$ (9-)15-21 μm ; clavate to narrowly vesiculose, rarely similar to pleurocystidia in shape; hyaline. Pileipellis composed of radial hyphae, end cells of some cystidioid but appressed, others narrow-cylindrical; 90-120 $\times$ 9-20 μm ; content gray brown; clamp connections profuse on pileipellis hyphae.

Habit, habitat, and distribution: Solitary to scattered on rotten hardwood logs (*Fagus*, etc.), occasionally on conifer logs. Not very common in the midwest (and sparsely distributed throughout the United States). May-August.

Collections examined: From study area: IL: Banerjee 790, Evergreen Park, Carbondale, Jackson Co. (SIU), Banerjee 928901, Little Grand Canyon, Jackson Co. (SIU), Monoson 361, Peoria Co. (Bradley); MI: Smith 51103, Oakland Co., Smith 37676, Emmet Co., Smith 25607, Cross Village (all at MICH). **Extralimital:** USA—CO: Smith 52641, Woods Lake, San Juan Mts. (MICH); NC: TN 14277, Indian Creek, Swain Co. (TENN); WA: Stuntz 10264 (WTU), Stuntz 2813, Mud Lake Bog (WTU); Canada—Ontario: Smith 26302, Petawawa, Ontario (MICH); Switzerland: JB 89/7/S.264 and JB 89/7/S.230 (both at LAU).

Commentary: The type is not available and probably destroyed. The bluish to greenish blue stains of the stipe, color of the pileus, ellipsoid spores, and numerous clamp connections on the pileipellis hyphae are good diagnostic characters. In fresh material, the walls of the pleurocystidia do not appear appreciably thickened. Sometimes they are thin-walled, and with rudimentary or aborted apical projections.

Pluteus salicinus* var. *achloes Sing., Trans. Br. Mycol. Soc. 39: 183. 1956.

Diagnostic characters: *Pileus* small (1.9-2.5 cm broad), drab to grayish, disc with spinules, basidiome lacks blue-green staining; clamp connections present on pileipellis hyphae.

Description: Pileus 1.9-2.5 cm broad; plane to convex with a slightly depressed disc when expanded; appressed-fibrillose and finely radially virgate with minute erect spine-like squamules over the disc; disc "fuscous" (R), elsewhere "drab" (R); context white, unchanging when bruised; odor none; taste disagreeable, soapy-metallic. Lamellae approximate to the stipe, close, broad (± 5 mm), "vinaceous" (R) to "vinaceous buff-pink" (R) to buff pink, edges concolorous; lamellulae 1-2-tiered. Stipe 2.6-5 cm long, 0.2-0.3 cm thick, equal; "smoky gray" (R) above, shading to "drab"

(R) (darker gray) at base, the basal fibrillose streaks staining gray on handling, surface satiny, glabrous and striatulate above, with a few appressed fibrillose streaks below, hollow, slightly flattened at apex.

Basidiospores 7-8.6 x 5.6-6 μm ; ellipsoid; smooth; wall slightly thickened. Basidia 24-27 x 7-8 μm , four-spored. Pleurocystidia 38-52(70) x 9-16(-19) μm ; ventricose to occasionally almost ellipsoid-pedicellate, with obtuse apices; ornamentation weak to aborted, rarely with large apical hooks, occasionally on the neck also; relatively thin-walled (0.6-1.0 μm thick) to moderately thick-walled (1.2-1.6 μm thick); hyaline. Cheilocystidia (34-)40-55 x 8-12(-17) μm ; narrowly clavate to slightly fusoid-ventricose with obtuse apices to short clavate-vesiculose-pedicellate; thin-walled; hyaline. Pileipellis hyphae 6-12 μm broad; end-cells often cystidioid and up to 18 μm in diam; content smoky brown; clamp connections present on pileipellis hyphae.

Habit, habitat, and distribution: Solitary to sparsely scattered on very rotten hardwood or conifer wood.

Collections examined: From study area: Singer 468 (holotype, F); MI: Smith 57464, Smith 57845, Smith 57847 (all at MICH). **Extralimital:** WA: Stuntz 10415 (WTU), Stuntz 2739, Middle Maple River Bridge (WTU).

Commentary: The morphological description is taken from Singer (1956). The lack of blue-green staining of the stipe base or any other part of the basidiome is the distinctive character for this variety. All other characters are typical of *P. salicinus*.

Pluteus salicinus* var. *americanus Banerj. & Sundb., Mycotaxon 47: 391. 1993. **Fig. 15.**

Diagnostic characters: Pileus medium-sized (5-6 cm broad); drab to hair brown, glabrous, hygrophanous, margin translucent-striate; spores large; some pleurocystidia with compound apical ornamentation; pileipellis hyphae with clamp connections.

Description: See Banerjee and Sundberg (1993a).

Collections examined: From study area: Smith 57841 (holotype, MICH); MI: Smith 57846, Smith 57099, Smith 57787 (all at MICH). **Extralimital:** NC: TN 14277, Indian Creek woods, Great Smoky Mts. National Park, Swain Co. (TENN).

Commentary: This taxon is distinct because of its glabrous, hygrophanous pileus with the translucent-striate margin when moist. The caps dry dark bluish-"fuscous" (R) which is quite distinct for a *Pluteus*, but this character is present to some extent throughout the varieties of *P. salicinus*.

Pluteus washingtonensis Murr. N. Amer. Fl. 10: 135. 1917.

Fig. 16.

Diagnostic characters: *Basidiome small (1.5-3 cm broad); pleurocystidia scattered, with obtuse apices crowned with 2-4(-6) weak projections, walls irregularly thickened; terminal elements of pileipellis hyphae versiform, clamp connections present.*

Description: Pileus 1.5-3 cm broad; convex, umbo lacking; "avellaneous" (R) to umbrinous, slightly darker on the disc; surface moist, glabrous, radiate-striate, margin entire and concolorous; odor and taste not known. Lamellae close, subventricose, white to "salmon" (K&W); margins entire and concolorous; lamellulae 1-2-tiered. Stipe 5-7 cm long, 0.2-0.4 cm thick; white (but see commentary); equal or slightly tapering upward; glabrous; hollow and somewhat fragile.

Basidiospores 6.6-8.4 x 5.4-6.4(-7) μm ; broadly ellipsoid to oval; smooth; wall slightly thickened; hilar appendix inconspicuous. Basidia 18-22 x 6-7.8 μm ; four-spored. Pleurocystidia scattered; 38-55(-70) x 8-12(-15) μm ; broadly cylindrical to subfusoid, with moderately thick necks ($\pm 1.8 \mu\text{m}$) and obtuse apices crowned with 2-4(-6) short and/or blunt projections; wall more or less uniformly thick; lateral ornamentation rarely present; all hyaline. Cheilocystidia 30-46 x 10-18 μm ; broadly clavate-pedicellate or sphaeropedunculate; smooth, thin-walled, hyaline. Pileipellis of radial hyphae 4-9(-20) μm in diameter; content uniformly dark brown; terminal elements versiform: some cylindrical, some subacute, a few ampullaceous or ventricose; clamp connections present but not on all pileipellis hyphae.

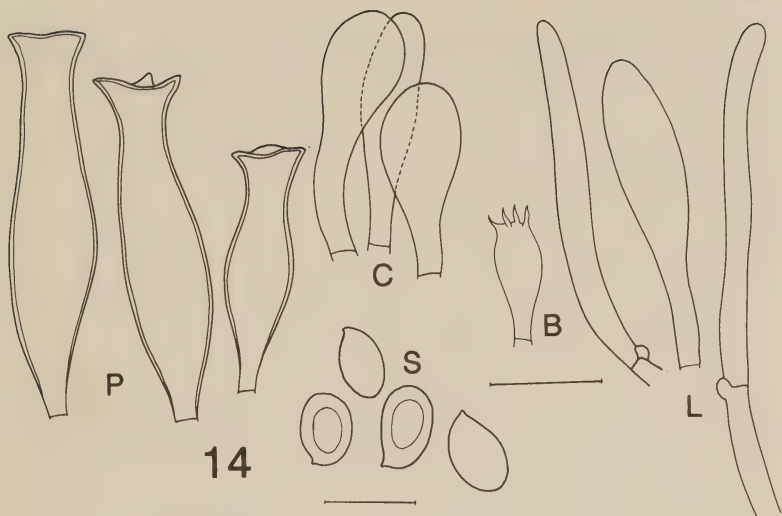
Habit, habitat, and distribution: Solitary, on decayed hardwood. Uncommon in the midwest.

Collections examined: From study area: MI: Smith 57824 (MICH).

Extralimital: ID Kauffman (collected on 9.4.22, MICH); WA: Stuntz 21834, University of Washington arboretum (WTU).

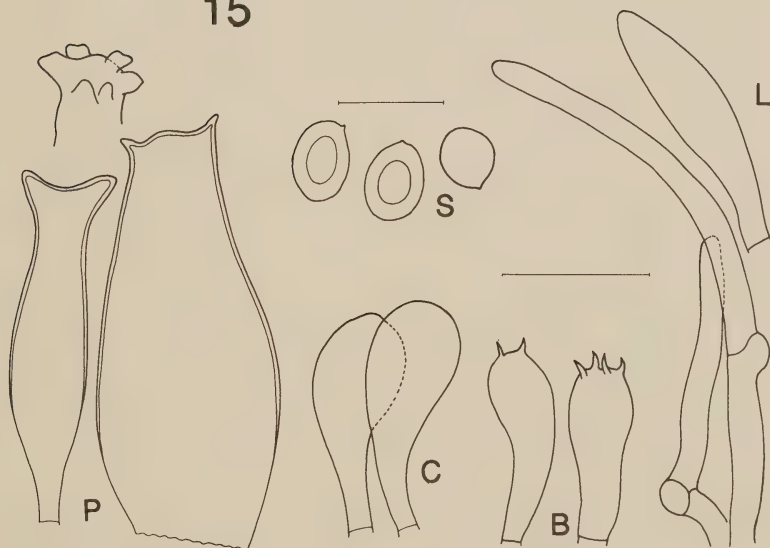
Commentary: The type specimen could not be examined and there are no data available on odor and taste. Some stipe hyphae have a fuscous internal pigment, therefore we concur with Singer (1956) that the stipe may not have been white. Presence of clamp connections on the pileipellis

Figs. 14 & 15. Characters of *Pluteus*. **14.** *P. salicinus*; **15.** *P. salicinus* var. *americanus*. P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, B—Basidia, S—Basidiospores. Scale lines: 10 μm for basidiospores, 20 μm for other structures.



14

15



hyphae and versiform terminal members of these hyphae are distinctive features. *P. washingtonensis* is probably related to *P. brunneidiscus* because of its small stature and pileipellis clamp connections.

Species in section *Pluteus* extralimital to the midwest of the U.S.

Pluteus australis Murr. Florida Acad. Sc. Proc. 7: 119. 1944(45).

Fig. 17.

Diagnostic characters: *Pileus* small to medium-sized (4-5 cm broad); *pleurocystidia* cervinus-type; *cheilocystidia* fusoid-ventricose to ampullaceous; *pileipellis* hyphae without clamp connections.

Description: *Pileus* 4-5 cm broad; umbonate, "bister" (R) on disc and brown near the margin; glabrous. Lamellae close, narrow; white becoming pink; edges fimbriate; lamellulae 1-2-tiered. Stipe 5.5 cm long, 0.4-0.5 cm thick; pallid, glabrous.

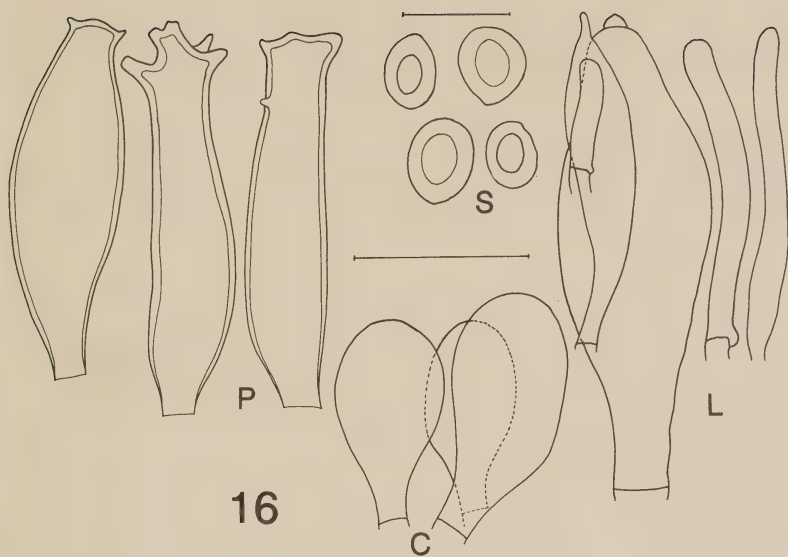
Basidiospores 6-7 x 4.2-4.4 μ m, oblong, smooth, hyaline; basidia 16-20.8(-25) x 5.8-8 μ m, four-spored. *Pleurocystidia* numerous, 45-75(82) x (8-)12-22(-28) μ m, fusoid-ventricose, with 2-4 apical horns, occasionally without horns, rarely with lateral spines; wall irregularly thickened, gradually becoming thinner toward the base; hyaline. *Cheilocystidia* 45-68(-78) x (7-)10-18(-24) μ m; fusoid-ventricose to ampullaceous; thin-walled; hyaline. *Pileipellis* of radial appressed filaments with yellow-brown content; clamp connections not observed on *pileipellis* hyphae.

Habit, habitat, and distribution: Solitary to gregarious, on dead hardwood log.

Collections examined: Murrill F 19140, Gainesville, Alachua Co, FL (holotype, FLAS); AL: Burke-BC (MICH).

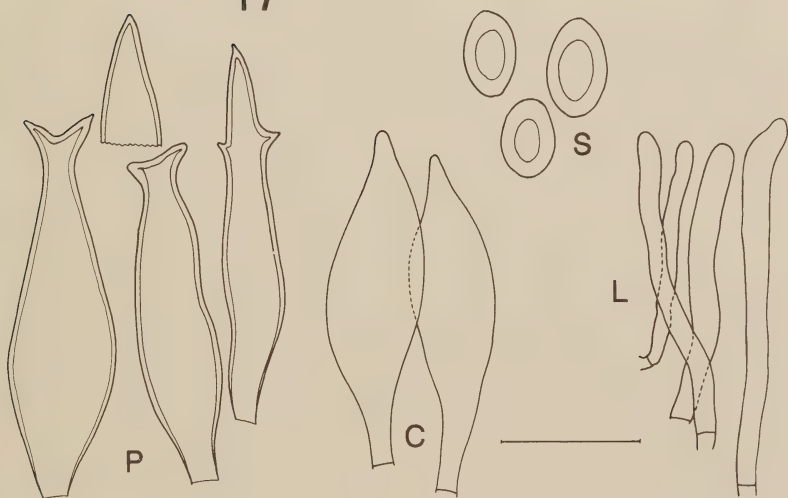
Commentary: The morphological notes above are adapted from Murrill (1944). Singer (1956) considered this species to be a possible synonym of *P. magnus*. However, the abundant unhooked *pleurocystidia* of *P. magnus* clearly distinguish it from *P. australis*. The narrow lamellae and fusoid ventricose to ampullaceous *cheilocystidia* distinguish *P. australis*

Figs. 16 & 17. Characters of *Pluteus*. 16. *P. washingtonensis*; 17. *P. australis*. P—*Pleurocystidia*, C—*Cheilocystidia*, L—*Pileipellis*, S—*Basidiospores*. Scale lines: 10 μ m for basidiospores, 20 μ m for other anatomical structures.



16

17



from *P. cervinus*. Finally, *P. australis* differs from *P. salicinus* based on color of the pileus, in lacking the blue staining on the stipe, and in lacking clamp connections on the pileipellis hyphae.

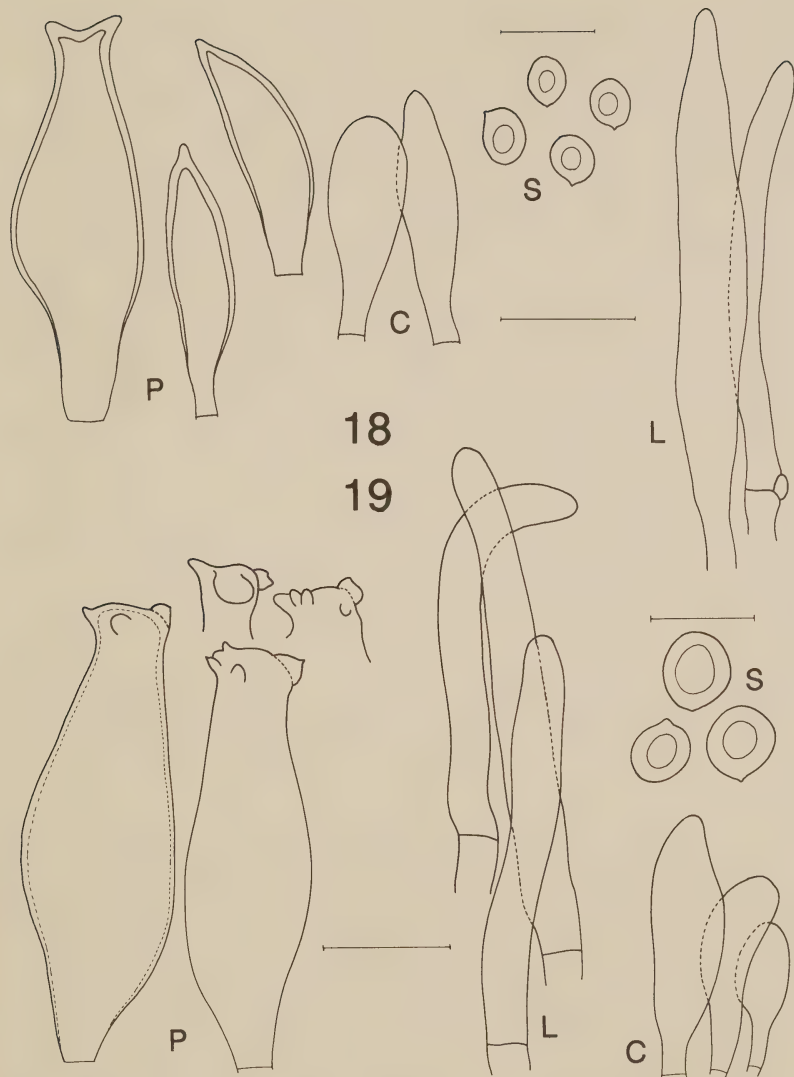
***Pluteus exilis* Sing., Fieldiana, Bot., p. 94. 1989. Fig. 18.**

Diagnostic characters: *Pileus* umber-brown, glabrous and naked; spores, cheilocystidia and pleurocystidia all more or less dimorphic; pileipellis hyphae without clamp connections.

Description: Pileus 3.5-5 cm broad; convex, finally becoming plane, usually subumbonate, rarely obtuse, never prominently umbonate; typically "umber" (RBG) brown, with innate radial fibrils but glabrous, naked, not striate, not sulcate; context white, unchanging; taste mild; odor not noticeable or mildly earthy farinaceous. Lamellae close; wide or moderately wide; rose-colored, margin concolorous, rarely slightly dark brownish; lamellulae 1-2-tiered. Stipe 4.4-6 x 3.5-5 cm, equal or gradually narrowing toward the apex (often up to 9 cm thick at base), pallid, with "umber" (RBG) brown or gray brown and parallel to somewhat reticulate fibrils at least over parts of the base; solid. Basidiospores pinkish yellow in mass.

Basidiospores dimorphic: (1) ovoid, 5.6-6 x 4.4-4.8 μm and (2) somewhat oblong, (6-)7-8 x 4.6-5.4(-6.4) μm ; the latter less frequent; both types with hilar appendix visible and walls moderately thin. Basidia 20-32 x 7-9.4 μm ; four-spored. Pleurocystidia dimorphic: (1) near lamellar edge typically *magnus*-type or *magnus*- and *cervinus*-type intermixed; 50-85 x 15-30 μm ; fusoid-ventricose, acute with or without sterigmatoid projections at apex; wall 2.0-2.2 μm thick; (2) typically *cervinus*-type on lamellar faces; 60-100 x 13-30.5 μm ; ventricose or ampullaceous, apex obtuse with 2-4 horn-shaped, straight, or rarely recurved acute or obtuse, short or long appendages; wall 1.6-2.2 μm thick, equal or gradually tapered below. Cheilocystidia in fascicles; relatively short, 15-35(-50) x 10-20 μm ; clavate, subvesiculose to vesiculose-pedicellate, apices broadly rounded, occasionally some fusoid-ventricose ones intermixed; thin-walled; hyaline. Pileipellis a trichoderm of semi-repent hyphae with rounded ends; 8-12 μm

Figs. 18 & 19. Characters of *Pluteus*. 18. *P. exilis*; 19. *P. harrisii*. P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 μm for basidiospores, 20 μm for other anatomical structures.



wide; with internal brown dissolved pigment; clamp connections lacking on pileipellis hyphae.

Habit, habitat, and distribution: Gregarious, on dead hardwood trunk.

Collection examined: Singer N 5105, Muir Woods, Marin Co., CA (holotype, F).

Commentary: The morphological description is translated from Singer's (1989) Latin. According to him, "This species differs from *P. atricapillus* (Batsch: Secr.) Sing. in its presence of dimorphic cheilocystidia and absence of superficial dark fibrils on the pileus as well as its thin stipe which hardly ever reaches 1 cm in diameter. It is closely related to *P. xylophilus* (Speg.) Sing. from South America. The latter has smaller spores, the carpophore being more variable in size, and grows on wood but never on Fagales." However, apart from the occasional fusoid-ventricose forms, intermixed and intergrading with the more common short pedicellate-vesiculose elements, no dimorphic cheilocystidia were observed. This species is possibly related to *P. major* Sing. (see commentary for *P. major*).

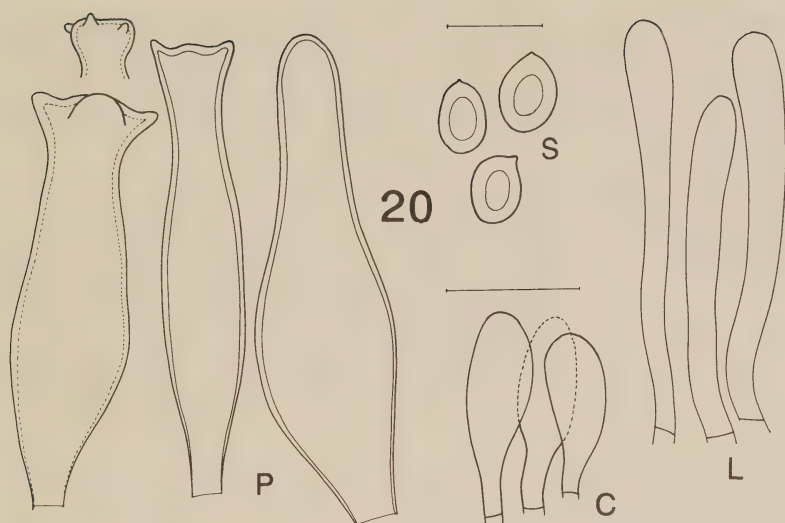
Pluteus harrisii Murr., Mycologia 3: 278. 1910. **Fig. 19.**

Diagnostic characters: Pileus small (2-3 cm broad); pleurocystidia with small and blunt apical versiform, upright, horizontal, recurved projections; some cystidia with an apical hyaline amorphous substance.

Description: Pileus 2-3 cm broad; convex to depressed, obtuse; surface "avellaneous" (R)-fuliginous to dark-chestnut; glabrous, subrugose, finely asperate and striate. Lamellae subclose, slightly ventricose; lamellulae 1-2-tiered. Stipe 3-4 cm long, 0.2-0.3 cm broad; white; cylindric; glabrous; solid.

Basidiospores 6-7.2(-8) μ m; subglobose; smooth; with a conspicuous hilar appendix, wall slightly thickened. Basidia 20-25 x 7-8.4 μ m; 4-sterigmate. Pleurocystidia abundant, even near gill edges; 50-80 x 15-25 μ m; clavate-ventricose; with (1-)2-5 small (up to 3[-5] μ m long) and blunt apical versiform upright to horizontal, recurved projections; a hyaline amorphous substance occurs within apical third of some cystidia; wall 2.2-2.6 μ m wide at neck, irregularly thickened. Cheilocystidia in fascicles; 39-46 x 12-20 μ m; vesiculose-pedicellate to elongate fusoid-pedicellate;

Fig. 20. Characters of *Pluteus*. 20. *P. heterocystis*. P—Pleurocystidia, C—Cheilocystidia, L—Pileipellis, S—Basidiospores. Scale lines: 10 μ m for basidiospores, 20 μ m for other anatomical structures.



smooth; thin-walled; hyaline. Pileipellis elements elongated with rounded ends; $\pm 100\ \mu\text{m}$ long, $4\text{--}10\ \mu\text{m}$ wide; some narrow ventricose; content homogeneous and brownish; clamp connections in pileipellis not seen.

Habit, habitat, and distribution: Solitary on dead wood. Troy and Tyre, Jamaica.

Collection examined: Murrill and Harris 956 (holotype, NY).

Commentary: The morphological notes are adapted from Murrill (1910). Singer (1956) found larger basidiospores. Otherwise, we agree with his description of characters. The versiform pleurocystidial hooks are noticeable. This species has some superficial resemblance to the South American species *P. xylophilus* (Speg.) Sing. However, *P. harrisii* has characteristic short, horizontally recurved prongs on its metuloids. Unlike *P. xylophilus*, *P. harrisii* never shows the innate longitudinal fibrils on its white slender stipe. *P. harrisii* is also smaller and darker.

Pluteus heterocystis Banerj. & Sundb., Mycotaxon 47: 392.

Fig. 20.

Diagnostic characters: *Pileus* medium-sized (5 cm broad); lamellae thick with eroded edges; pleurocystidia dimorphic, apices truncated with short ornamentations; clamp connections absent on pileipellis hyphae.

Description: See Banerjee and Sundberg (1993a).

Habit, habitat, and distribution: Solitary on soil, Hoh River, Olympic National Park, Washington.

Collection examined: Smith 13616 (holotype, MICH).

Commentary: The thickish lamellae with eroded edges, two types of pleurocystidia, and truncated pleurocystidial apices with short ornamentations are distinctive.

Phylogenetic analyses of *Pluteus* section *Pluteus* taxa in the United States based on morphological and anatomical characters.

Of a total of 63 characters that were scored for all 25 operational taxonomic units (OTUs), 57 characters varied in two or more taxa and were thus phylogenetically informative (Table I). The complete character matrix is shown in Table II. Two different weighting schemes were used for phylogenetic analysis using PAUP. The results are as follows.

Monophyly of most taxa was not supported by the results in either of the analyses. One hundred bootstrap replications did not help resolve relationships any further because they created some unresolved polytomies. Results from these replications will not be discussed here.

In the following descriptions of trees, the taxa discussed in their respective clades are from the most distal to proximal regions to the outgroup taxa.

Unweighted characters with standard ancestry for all characters.—Using unweighted characters, a total of 23 most parsimonious trees were obtained. Most taxonomic groupings resolved by parsimony analysis were found to be highly concordant among the most parsimonious trees, which is indicated by complete (100%) or nearly complete consensus frequencies (i.e., consensus positions among the majority of most parsimonious trees) in the 50% majority-rule topology shown in Fig. 21.

P. atricapillus, *P. exilis*, and *P. major* are grouped together by majority of the most parsimonious trees, though at a low frequency. However, several groups of taxa were supported by all of the most parsimonious trees. These groups include *P. brunneidiscus*, *P. laricinus*, and *P. washingtonensis* in one cluster, *P. salicinus*, *P. salicinus* var. *achloes*, and *P. salicinus* var. *americanus* in another cluster, and *P. heterocystis* and *P. cinerascens* grouped separately. *P. cervinus* fell in next, then came the next few groups of taxa, the first of which included *P. atromarginatus* and *P. atropungens* with 100% and *P. cervinus* var. *scaber* with 94% consensus frequencies among the most parsimonious trees. *P. petasatus*, *P. pellitus*, *P. patricius*, and *P. magnus* came out separately on individual clades, almost all with a high consensus frequency.

Among the outgroup taxa, *P. admirabilis* was positioned next to *P. magnus*. *Amanita gemmata* and *Nolanea cystomarginata* were grouped together with a 100% consensus frequency among the most parsimonious trees, and *Volvariella diplasia* was the most remotely placed outgroup.

Weighted characters with mixed ancestry for seven

TABLE II
MORPHOLOGICAL-ANATOMICAL CHARACTER MATRIX OF TAXA IN SECTION *PLUTEUS*
FOR PAUP PHYLOGENETIC ANALYSES¹

Operational Taxonomic Units	Characters and Character States
<i>Pluteus atricapillus</i>	1111111111222222223333333333444444444455555555556666
<i>P. atranginatus</i>	12345678901234567890123456789012345678901234567890123
<i>P. atropurgens</i>	1a0000011000101001001000001101007001010100110a0???070??0001
<i>P. australis</i>	110000000001000010001000100000110100700000110110000???070??0000
<i>P. brunneidiscus</i>	100010000?01011110010?000001101007000000110110010???070??0000
<i>P. cervinus</i>	1100001111?100100?0001?11000110101?00000100?00000???070??0001
<i>P. cervinus</i> var. <i>scaber</i>	111000010010000000010010000011010070100000000000???070??0001
<i>P. cinerascens</i>	110000011000000100100110000011010070000001011100a0???070??0001
<i>P. exilis</i>	1a01000107000100000100?110011101007000010000010000???070??0001
<i>P. harrisi</i>	1a000?01101a1000100000?000001101007000011000110010???070??0001
<i>P. heterocystis</i>	11001?0111?10000?0100?000001101?100000?011000?0?070??0001
<i>P. loricinus</i>	1a1000a111?00000?21000?01000110000?010010000010000???070??0001
<i>P. magnus</i>	1a001?0000?000000?0100?00000110100?011010100010000???070??0000
<i>P. major</i>	000000110000?00000110?000011010070011000101110000???070??0001
<i>P. patricius</i>	0a000001107a001a10?0100?00001101107000010100?00010???070??0001
<i>P. pellitus</i>	00010011100000000110100000001100000010000001100a0???070??0001
<i>P. petasatus</i>	1101000110000000001100001001100100000000001100a0???070??0001
<i>P. salicinus</i>	11010a111010010011000000000110000?0010011001100a0???070??0001
<i>P. salicinus</i> var. <i>achloes</i>	111001010001000100101010100011010000000101a0???010??0001
<i>P. salicinus</i> var. <i>americanus</i>	01110110100010001001000001010110100?11100000010000???010??0001
<i>P. washingtonensis</i>	0110010100000001111001010110000?111000000000100???010??0001
<i>P. admirabilis</i>	11101001000000100?0010?00000110100011100000010000???070??0001
<i>Volvarrella diplasia</i>	0011100110000000000100100000110000?00000000000010???070??0001
<i>Ananeta gemmata</i>	0001000100010001000010000a0011000a00110000?00110000010001110100??0001
<i>Nolanea cystomarginata</i>	?00100?11110100100?01001?000?01?0101??21001011011011000001 000011101101?10000100?01000110000100000100010010???2111

¹Number of taxa (with 4 outgroups):25; number of characters:63; missing data:?. character states:0,1; polymorphic state (0):a.

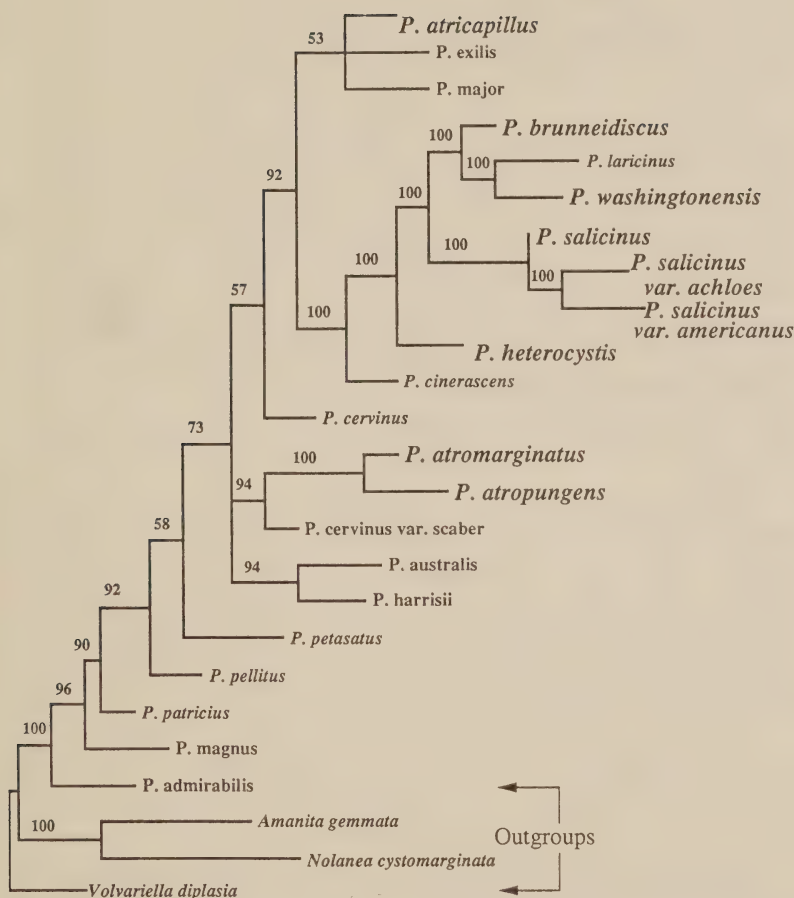


Fig. 21. Fifty percent majority-rule consensus PAUP topology tree showing phylogenetic relationships of section *Pluteus* taxa (using heuristic search and 57 unweighted informative morphological characters). Numbers shown are frequencies of consensus positions found among the 23 most parsimonious trees. Taxa in larger italics are at similar relative positions in all three types of cladistic analyses. Taxa in smaller italics are at similar relative positions in this and the strict consensus analysis.

characters.—Using weighted and polarized characters, a total of 17 most parsimonious trees were obtained. Here also, most taxonomic groupings resolved by parsimony analysis were found to be highly concordant among the most parsimonious trees, which is indicated by complete (100%) or nearly complete consensus frequencies in the majority-rule topology shown in Fig. 22.

Character weighting with mixed ancestry changed the relative positions of some of the taxa. In the first group of taxa, *P. atricapillus*, *P. atromarginatus*, *P. atropungens*, *P. laricinus*, and *P. exilis* were clustered together where all had a 100% consensus frequency among the most parsimonious trees. In the second group, *P. australis*, *P. harrisii*, *P. cervinus*, and *P. cervinus* var. *scaber* were clustered. In the third, *P. brunneidiscus*, *P. salicinus* and its two varieties, and *P. washingtonensis*, and *P. heterocystis* were grouped, and the fourth, *P. cinerascens*, *P. pellitus*, and *P. petasatus* were clustered. *P. magnus* and *P. major* segregated on separate branches, and *P. patricius* came out singly on a separate clade along with the outgroups. *P. admirabilis* segregated singly on the most remote clade. Almost all clades had 100% consensus frequencies.

Strict consensus tree using unweighted characters and standard ancestry.—Using unweighted characters and standard ancestry for all informative characters, a total of 23 most parsimonious trees were obtained. Out of these trees, a strict consensus tree was constructed to depict the most conservative relationships among the taxa (Fig. 23). In this analysis, some taxa showed relationships concordant with the other two analyses. However, relationships among some other taxa were not well-resolved because of the polytomies the tree produced.

P. atricapillus was placed on the end most remote from the outgroups thus showing agreement in its relative position in all three analyses. *P. atromarginatus* and *P. atropungens* were clustered together. Among the other well-resolved positions of taxa, *P. brunneidiscus* and *P. washingtonensis* were grouped close to the *salicinus* complex. *P. heterocystis* also related to the latter group showing agreement among the analyses. The relative positions of *P. laricinus* and *P. cinerascens* on this tree were similar in the other analysis using unweighted characters.

No good resolution was found in the relationships of the other taxa. *P. cervinus* and its variety *scaber* were clustered together, and the traditionally related species *patricius*, *pellitus*, and *petasatus* were closely

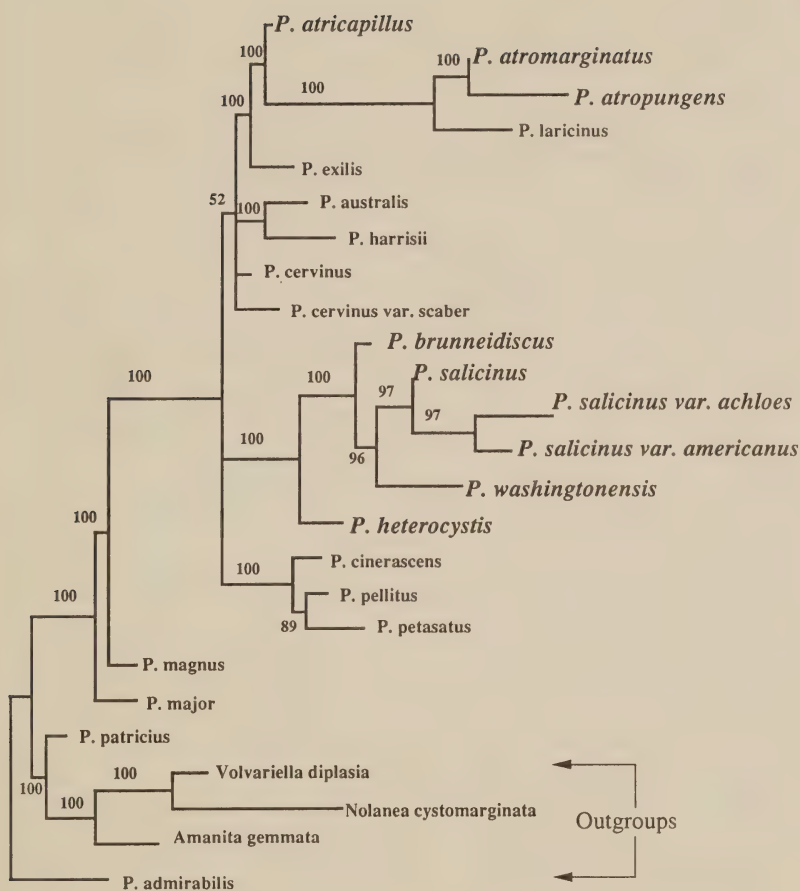


Fig. 22. Fifty percent majority-rule consensus PAUP topology tree showing phylogenetic relationships of section *Pluteus* taxa (using heuristic search and 57 *weighted* informative morphological characters and mixed ancestral states for seven characters--see text for details). Numbers shown are frequencies of consensus positions found among the 17 most parsimonious trees. Taxa in italics are at similar relative positions in all three types of cladistic analyses.

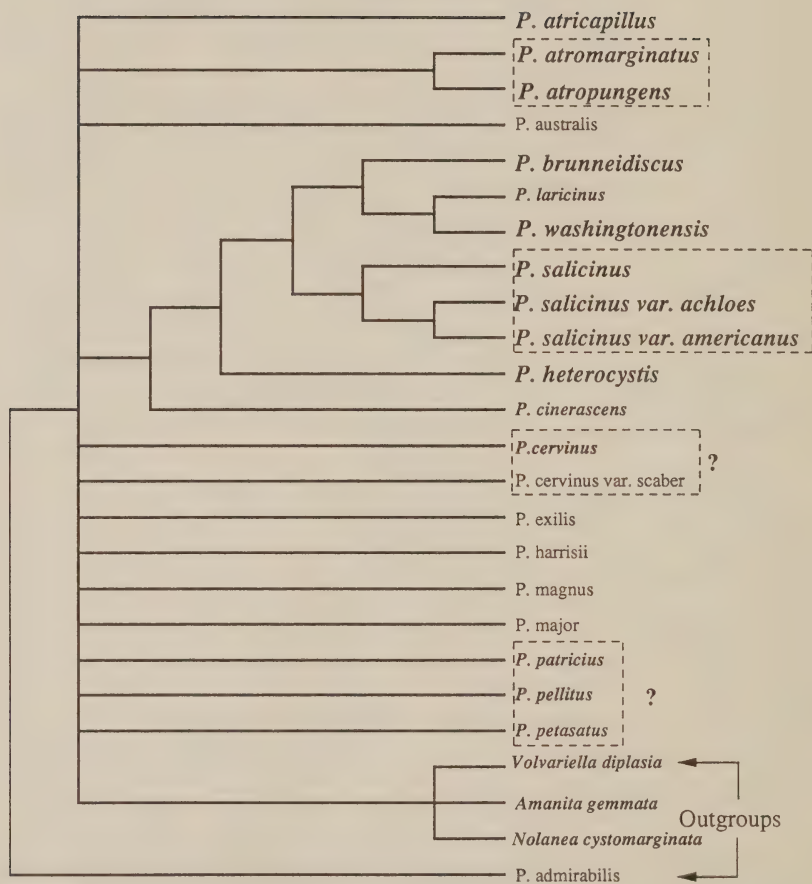


Fig. 23. Strict consensus PAUP tree of 23 most parsimonious trees showing phylogenetic relationships of section *Pluteus* taxa (using heuristic search and 57 unweighted and only informative morphological characters). Taxa in larger italics are at similar relative positions in all three types of cladistic analyses. Taxa in smaller italics are at similar positions on this and topology tree using unweighted characters. Taxa in boxes are traditionally known to be related, but the ones with question marks now have uncertain affinities based on our studies. Other taxa do not show any congruent positions in the three analyses.

positioned. However, based on the morphology and anatomy of these taxa and their relative positions on the other trees (see Figs. 21 and 22), it is uncertain whether their traditionally-held affinities are true or not.

The strict consensus tree yielded perhaps a too conservative cladogram which did not help resolve relationships among many of the taxa. However, the two other analyses gave reasonably good resolution for inferring phylogeny. The following comparisons were made based on these two analyses (Figs. 21 and 22).

In both cases, *P. australis* and *P. harrisii* were clustered in one group, *P. atromarginatus* and *P. atropungens* in another group, and *P. salicinus* and its two other varieties in yet another group. The consensus frequencies among the most parsimonious trees were high in all cases. However, the relative phylogenetic position of these clusters varied. *P. brunneidiscus*, *P. washingtonensis* and *P. heterocystis* always associated with the *P. salicinus* group, showing close phylogenetic relationships with the latter group. In particular, *P. brunneidiscus* and *P. washingtonensis* were clustered more closely with the *P. salicinus* group, which probably indicates phylogenetic relationships among species with clamp connections in the pileipellis. This also points out the importance of clamp connections as a taxonomic character in *Pluteus* taxonomy, which has been emphasized in classification schemes of authors such as Singer (1956, 1986, pers. comm.), Smith (unpublished), and Vellinga (in Bas et al., 1990). As expected from their morphology and anatomy, *P. atromarginatus* and *P. atropungens* clustered close together. However, the close proximity of *P. australis* and *P. harrisii* in both analyses cannot be easily explained.

P. petasatus did not form a monophyletic group with *P. patricius* in either case, thus strengthening our hypothesis that these two taxa are separate taxonomic entities (see commentaries on these two species).

P. pellitus showed phylogenetic proximity with *P. petasatus*. Apparently, the white pileus and stipe are important association characters.

The two topology trees differed in several respects: In the case of unweighted characters, *P. exilis* and *P. major* were associated with *P. atricapillus*, but with weighted characters, *P. major* was far removed from the *P. atricapillus*-*P. exilis* clade. One might argue that weighting of some characters imposed artificial distance between these two species. On the other hand, *P. cervinus* and *P. cervinus* var. *scaber* showed close proximity when weighted characters were applied in the analysis, but were removed from each other when the characters were unweighted. In the latter case,

P. cervinus var. *scaber* showed association with *P. atromarginatus* and *P. atropungens*. *P. cervinus* var. *scaber* is clearly a problem taxon, as its overall morphological similarity (scales, dark color) suggests its relation with the marginate-gilled species; yet anatomically it is more related to *P. cervinus*. More data, especially data from cultural and molecular studies, are needed to resolve this problem.

Among other species, marginate-gilled *P. laricinus* was associated with the other marginate-gilled species *P. atromarginatus* and *P. atropungens* when characters were weighted. In the unweighted-character scenario, that was not the case. This shows the bias one could have if traditionally important characters are given too much preference over other less frequently used characters to resolve phylogeny. Here also, to disentangle the taxonomic knot, one could resort to cultural and molecular data.

In conclusion, Simpson (1944, in Cohen, 1994) argued that evolutionary biology should draw from many diverse disciplines. No data are unimportant, and every effort should be made to help create a large database using traditional and other characters to resolve interrelationships among taxa and their phylogeny. Some research has been done in this direction, but there is indeed room for much more.

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STUDIES IN THE GENUS *PLEUROTUS*, IV. OBSERVATIONS ON THE PINK FORMS GROWING IN MEXICO BASED IN THE INTERBREEDING OF TWO DIFFERENT STRAINS

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ABSTRACT

The two pink forms of *Pleurotus* known in Mexico based in two strains isolated from wild specimens, one with white spore print (IE-134), and other with salmon color to pinkish-brown spore print (IBUG-7₆) were studied. Both are compatible between them and with *P. djamor*. However, under poor conditions of light the strain IBUG-7₆ produced basidiomata pallid brownish-beige with whitish spore prints, and the basidiomata from the strain IE-134 fading to whitish. It is concluded that *P. djamor*, which is very common in tropical and subtropical regions of Mexico, has two ecological pink varieties, i) *roseus* (strain IE-134) and ii) *salmonestramineus* (strain IBUG-7₆), the first differs by the white spore print in the wild forms, and the later by the pigmented spore print in wild specimens.

INTRODUCTION

Pleurotus ostreatoroseus Singer is a neotropical, and attractive edible mushroom because of its pinkish basidiomata. It was described by Singer (1961) from Brazil but Singer (1962) cited it as *P. roseopileatus* Singer (*nomen nudum*). Guzmán (1977) recorded this fungus for the first time from Mexico, in coffee plantations and tropical forests, and afterwards it was frequently reported in Mexican bibliography. Welden and Guzmán (1978), Guzmán-Dávalos and Guzmán (1979), Guzmán-Dávalos *et al.* (1983), Guzmán and Guzmán-Dávalos (1984), Portugal *et al.* (1985), Mata (1987) and Cedano *et al.* (1993) registered *P. ostreatoroseus* from several localities at the States of Jalisco, Morelos, Veracruz and Yucatan. Vilchis-Argueta and Pinzón-Picaseño (1984) reported a white rot in *P. ostreatoroseus* in a strain from the State of Veracruz. Guzmán-Dávalos and Soto-Velazco (1987), Cedano-Maldonado (1989), Martínez-Carrera (1989), Arias *et al.* (1991) and Cedano *et al.* (1993) cultivated this fungus in Mexico. The later work reported the sexual pattern and provided a chemical analysis of the obtained basidiomata. Sosa-Melgarejo (1989) studied the germination of basidiospores. Also in Mexico, Guzmán *et al.* (1993b) discussed some relationships of *P. djamor* (as *P. djamour*) with the pinkish varieties described by Corner from Malaysia (see below). In South America, Capelari and Maziero (1988) recorded the species from Brazil. Later Bononi *et al.* (1991) cultivated a strain isolated from a specimen collected by Capelari.

On the other hand, Corner (1981) described two pink forms of *P. djamor* (Fr.) Boedijn from Malaysia, *P. djamor* var. *roseus* Corner and *P. djamor* var. *fuscroseus* Corner, relating this later taxon with *P. ostreatoroseus*. Vassileva (1973) and Hongo (1973) also described two pink mushrooms, *P. salmoneostramineus* Vass. from eastern Russia, and *P. incarnatus* Hongo from Japan. Imazaqui *et al.* (1988) considered the pink Japanese mushroom as *P. salmoneostramineus*. Zadrazil (1979), Murakami and Takemaru (1990), Murakami (1991), Zadrazil and Dube (1992) and Suzuki (1992) cultivated *P. salmoneostramineus*. Neda *et al.* (1988) showed the compatibility between *P. salmoneostramineus* and *P. djamor*. Murakami and Takemaru (1990) also considered the species of Hongo synonymous of

Vassileva's species, and obtained albino forms; afterwards Murakami (1991) discussed the possibility of *P. salmoneostramineus* to be a mutant of *P. djamor*. Hilber (1989) pointed out that *P. salmoneostramineus* is a synonym of *P. euosmus* (Berk.) Sacc., a concept followed by Zadrazil and Dube (1992). Pegler (1977) studied the type of this species (as *P. eöus*) from India and Corner (1981) supposed that this species may be conspecific with *P. djamor* var. *roseus*. Saccardo (1887) and Cooke (1881-1883) briefly discussed *P. eosmus*. Arias *et al.* (1991) showed the compatibility between *P. djamor* (as *P. ostreatus*) and *P. ostreatoroseus*. Petersen and Hughes (1993) showed the compatibility between a Mexican strain of this complex (IBUG-7₅) and a Japanese strain of *P. salmoneostramineus*, but observed the incompatibility of them with strains of *P. djamor* from Mexico and Puerto Rico. Finally, Stamets (1993) obtained albino basidiomata from pink forms, and observed that according to the basidiomata color was the spore print color and concluded that pink fungi are a complex of the "pink oyster mushrooms".

Considering the confusions on these pink taxa, the present paper has the objective to elucidate the taxonomy of this group in Mexico. This contribution is a continuation of those developed by the authors on the genus *Pleurotus* (Guzmán *et al.*, 1991, 1993b, 1994).

MATERIALS AND METHODS

Collections of the pink forms of *Pleurotus* from Mexico and Brazil, deposited at XAL Herbarium, and some deposited at IBUG Herbarium were studied, as well as 11 collections obtained by culture at a mushroom house. A collection of *P. incarnatus* from Japan was also studied. The type of *P. ostreatoroseus* was impossible to located at BAFC, F, FH and LIL. Strains IE-134 and IBUG-7₅ were studied, the first isolated in the Instituto de Ecología from the collection of Tapia 549 from Xalapa region and the later was kindly supplied by Guzmán-Dávalos and Soto-Velazco from the University of Guadalajara and it was isolated from a collection in Guadalajara, as Cedano *et al.* (1993) stated.

The strain IE-11 of *P. djamor* from Guatemala (Guzmán *et al.*, 1993b) was interbreed with strains IE-134 and IBUG-7₅. The

cultures and interbreeding methods were according to Guzmán *et al.* (1993a, 1993b, 1994). The microscopic studies were made with sections mounted in 5 % KOH, Congo red, cotton blue and Melzer's solution. Colors specified in the descriptions are based on Kornerup and Wanscher (1978).

RESULTS

Strains interbreeding

The two pink strains IE-134 from Xalapa and IBUG-7₅ from Guadalajara were 100 % compatible between them and with strain IE-11 of *Pleurotus djamor* from Guatemala, supporting their relationships and so determined as *P. djamor*. However, according to the pink basidiomata and color variations of spore prints, they represent two close varieties as discussed below. It is important to state, that strain IE-11 from Guatemala is also intercompatible with several strains from Mexico, as the authors found recently.

Study of the basidiomata obtained by culture

The spore print color, the robustness and the pigmentation of the basidiomata, seem the major differences between the basidiomata produced by strains IE-134 and IBUG-7₅. The first strain generally produces pale pinkish, medium size basidiomata (up to 120 mm wide) and white spore prints, while the latter regularly present darker and more robust basidiomata (up to 165 mm wide) and salmon color or pinkish-brown spore prints. Considering the pink varieties proposed by Corner (1981), *P. djamor* var. *roseus* and *P. djamor* var. *fuscroseus* both with white spore prints, and taking into account that *P. salmoneostramineus* Vassileva (= *P. incarnatus* Hongo, 1973) has salmon color spore print (Vassileva, 1973), strain IE-134 could be related to *P. djamor* var. *roseus* and var. *fuscroseus* and strain IBUG-7₅ to *P. salmoneostramineus*.

However, the variations of the basidiomata observed under culture, showed that under poor illumination at the mushroom house, strain IBUG-7₅ produced pallid brownish-beige (5B3 pallid) basidiomata and whitish spore prints; but under normal conditions of illumination the cultivated basidiomata tend to be more pigmented than the wild forms, which presented pileus pallid pink color. On the other hand, the basidiomata produced by strain IE-

134 at the mushroom house did not present the typical pink tones of the wild specimens, while they were more pallid than the wild form. The primordia of both strains were pallid grayish-brown (4B3-4B1), marfil (2A2) or with pinkish tones (5A2), although in strain IE-134 were more white in comparison with strain IBUG-7₅ that were more frequently pink, both inside or outside of the mushroom house.

Microscopical features of the basidiomata obtained by culture (Figs. 1-18)

Strain IE-134

Spores (6.4-) 7.2-9.6 x 3.2-4 μm , cylindric-ellipsoid, hyaline, thin walled. Basidia (20-) 24-28 x 4-5.6 (-6.4) μm , tetrasporic, claviform, hyaline. Cystidioid elements 14.4-20 (-24) (-26.4) x (4-) 4.8-6.4 μm , common at sides or at edges of the gills, ventricose, mucronate or lecythiform, thin walled, hyaline, frequently with a mucilaginous hyaline drop at apex. Pleurocystidia absent. Cheilocystidia (16-) 18.4-28 x 6.4-9.6 (-12) μm , widely-claviform, hyaline, thin-walled. Hyphal system dimitic. Context with both generative and skeletal hyaline hyphae, the first 1.6-9.6 (-12) μm wide, thin walled (wall up to 1.6 μm thick), and the later 2.4-6.4 (-8) μm wide, with wall up to 2.4 μm thick. Hymenial trama irregular, with generative hyphae 1.6-8 (-8.8) μm wide, thin walled (up to 1.6 μm) and skeletal hyphae 2.4-7.2 μm wide with thick wall up to 2.4 μm thick. Generative hyphae clamped. Pileal surface hyphae with radial arrangement, postrated, 4-6.4 μm wide, hyaline, thin-walled (wall up to 0.8 μm thick), clamped. Pileocystidia 14.4-44 x 4-6.4 μm , subcylindric or subclavate, thin-walled, sometimes clamped at the base, in fascicles.

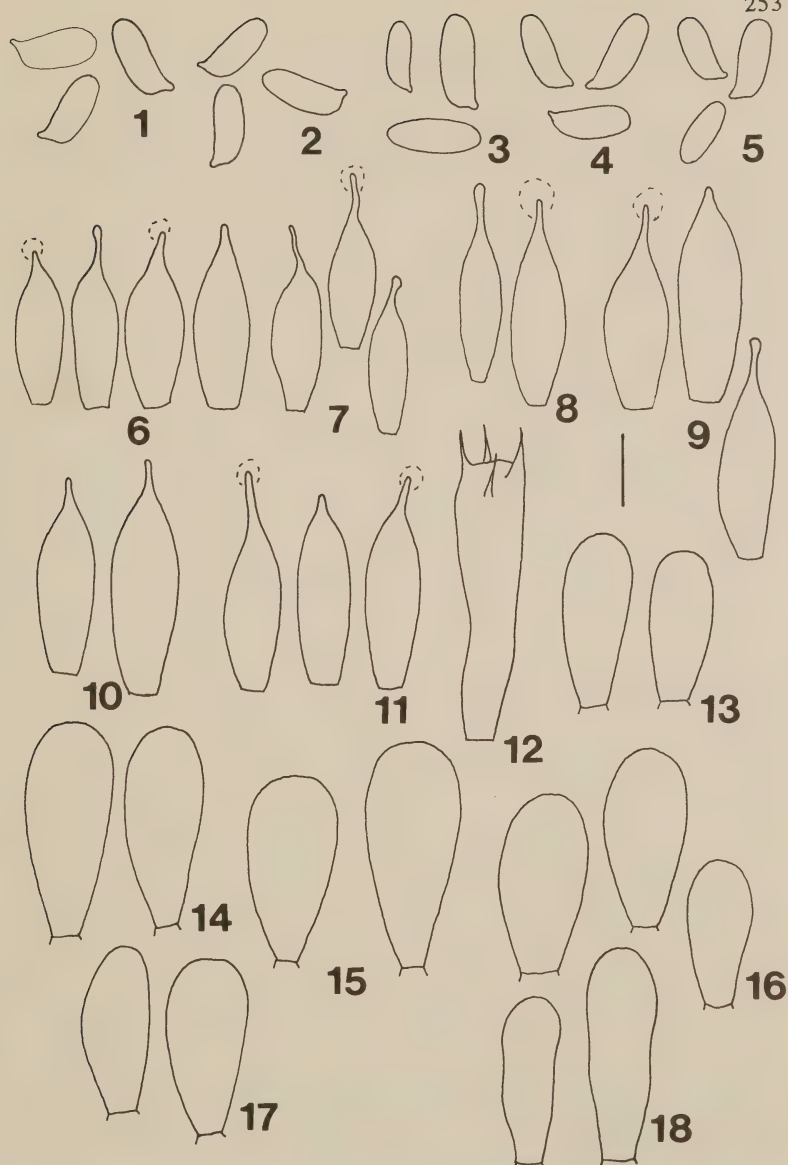
Strain IBUG-7₅

Spores (6.4-) 7.2-9.6 (-10.4) x 3.2-4 μm , cylindric-ellipsoid, hyaline, thin walled. Basidia (20-) 24-28 x 4-6.4 μm , tetrasporic, claviform, hyaline. Cystidioid elements 20-24 (-26.4) x 6.4-8 μm , common, ventricose, mucronate or lecythiform, hyaline, thin walled, frequently with a mucilaginous hyaline drop at apex. Pleurocystidia absent. Cheilocystidia (15.2) 18.4-28 x (6.4) 7.2-12 μm , widely claviform, hyaline, thin walled, mixed

with the cystidioid elements. Hyphal system dimitic. Context with both generative and skeletal hyphae, the former 2.4-12 (-13.6) μm wide, thin walled up to 1.6 μm thick, and the later 2.4-6.4 μm wide, with thick wall up to 2.4 μm thick. Hymenial trama irregular, with generative and skeletal hyaline hypha, the former 2.4-11.2 μm wide and thin walled, with wall up to 1.6 μm thick and the skeletal hyphae 3.2-5.6 μm wide, with wall up to 2.4 μm thick. Generative hyphae clamped. Pileal surface hyphae with radial arrangement, postrated, 3.2-6.4 μm wide, hyaline, thin-walled (wall up to 0.8 μm thick), clamped. Pileocystidia 16-41.6 (-56.8) $\times$ 4-6.4 (-7.2) μm , cylindric or subclavate, sometimes clamped at the base, in fascicles, rarely mixed with cystidioid elements.

Wild and cultured collections examined

BRAZIL, Sao Paulo, Forest of the Instituto Forestal, May 18, 1983, Guzmán 23125 (XAL). **JAPAN**, Kyoto, Shimogamo, June 23, 1974, Yokoyama 2145 (Herb. Yokoyama as *P. incarnatus*; XAL). **MEXICO**, Jalisco, Chiquistan, June 28, 1986, Lozano 11 (IBUG). Yahualica, July 4, 1986, Pérez-Fabián 8 (IBUG). Guadalajara, Sector Libertad, Sept. 19, 1986, Guzmán-Dávalos 3766 (IBUG). **From this later specimen was isolated the strain IBUG-7₅ at Guadalajara**, from which the basidiomata Guzmán 29607, 30640, 30643, 30645, and Montoya 2024, 2109, 2110, 2133 (all at XAL) were developed. Veracruz, road Córdoba to Orizaba, Barranca de Metlac, near the Planta Hidroeléctrica, July 8, 1983, Guzmán 23364, 23365, 23366 (all at XAL). Córdoba, 1st. Exposition of Mushrooms, Aug. 26, 1986, Bandala 1839 (XAL). Old road Xalapa to Coatepec, near Instituto de Ecología, Aug. 31, 1993, Montoya 2162 (XAL); Rancho Santa Inés, May 15, 1991, Tapia 549 (XAL). **From the later specimen the strain IE-134 was isolated** and basidiomata Guzmán 30452 and Montoya 2053 and 2090 (all at XAL) were obtained. Yucatán, Pixoy, Valladolid Municipio, Aug. 18, 1987, Mata 269 (XAL). Zacatecas, road San Cristobal de la Barranca to Colotlán, between Gigante and La Huizachera, breach to El Malacate, June 1987, Martínez 3 (IBUG); June 8, 1987, Guzmán-Dávalos 3728 (IBUG).



Figs. 1-18. Microscopic features of the studied collections. 1-5: spores, 6-11: cystidioid elements, 12: basidium, 13-18: cheilocystidia (1, 6, 13 from Tapia 549; 2, 7, 14 from Guzmán 30452; 3, 8, 15 from Guzmán 23125; 4, 9, 12, 16 from Montoya 2024; 5, 11, 18 from Yokoyama 2145; 10 & 17 from Montoya 2010). Scale = 8 μ m.

DISCUSSION

The pink forms of *Pleurotus* reported in the bibliography are a complex of at least 5 taxa: *P. djamor* var. *fuscroseus* Corner, *P. djamor* var. *roseus* Corner, *P. euosmus* (Berk.) Sacc. [= *P. eöus* (Berk.) Sacc.], *P. ostreatoroseus* Singer and *P. salmoneostramineus* Vassileva (= *P. incarnatus* Hongo, according to Murakami and Takemaru, 1990), besides *P. djamor* (Fr.) Boedijn var. *djamor*. Probably all these taxa are the same. Concerning *P. ostreatoroseus* there is no information about the color of the spore print and the type seems lost. Neda *et al.* (1988) showed the compatibility between the typical form of *P. djamor* and *P. salmoneostramineus*. Murakami and Takemaru (1990) obtained albino basidiomata with white spore prints from *P. salmoneostramineus*, and suggested that the albino forms are formed by a heritable character in a recessive gene. Stamets (1993) also obtained albino forms from a pink *Pleurotus* identified by him as *P. djamor*. Arias *et al.* (1991) found that *P. djamor* (identified as *P. ostreatus*) is compatible with strain IBUG-7₅, identified as *P. ostreatoroseus*. Petersen and Hughes (1993) considered *P. djamor* and *P. salmoneostramineus* as putative taxa of the complex *P. ostreatus* (Jacq. : Fr.) Kumm.- *P. pulmonarius* Fr. and showed the compatibility between a Japanese strain of *P. salmoneostramineus* with strain IBUG-7₅, and the incompatibility of strains of *P. djamor* from Tabasco (Mexico) and Puerto Rico with the Japanese strain and with IBUG-7₅. Undoubtedly, the strains from Tabasco and Puerto Rico do not belong to *P. djamor*-complex. Guzmán *et al.* (1993b) noted that some wild Mexican specimens of *P. djamor* are probably adscribed to *P. djamor* var. *roseus* Corner and others are intermediate between both varieties.

According to the experiences of the present paper, two wild pink forms of *Pleurotus* can be considered in Mexico, one with white spore print found at Xalapa region (strain IE-134) and other with salmon color or pinkish-brown spore print isolated from Guadalajara region (IBUG-7₅). However, both are intercompatible and under certain culture conditions strain IBUG-7₅ produces whitish basidiomata with white spore print. The basidiomata from strain IE-134 fading frequently to whitish. Also these strains are compatible with *P. djamor*. The basidiomata of both studied pink

strains produced by culture were more robust than those in the wild forms, up to 120 mm wide in strain IE-134 and up to 165 mm wide in the IBUG-7₅ vs. 20-30 mm wide in both wild forms. *P. djamor* produces white primordia or with pinkish tones (5A2), as Guzmán *et al.* (1993b) observed. It seems that the pink form with white spore print is common in the tropical and subtropical regions at SE of Mexico, while the pink form with pink spore print is more common in the State of Jalisco and also in the State of Zacatecas. However, both forms, were found in the same locality at Barranca de Metlac, in the State of Veracruz.

Referring to the odor and flavor, the basidiomata of both studied strains did not show differences respecting to the wild forms. Both strains presented basidiomata with farinaceous flavor and odor context. In this respect it is interesting to observe, that these two pink forms studied present the same flavor and odor of the wild and cultivated *P. djamor*, different to the fungoid flavor and odor of to *P. ostreatus*. Referring to this, Stamets (1993) says: "*The flavor of this mushroom -the pink cultivated forms- is not as appealing as many of the other Oyster species*" (*P. ostreatus* and related species).

Microscopically there are no differences between the basidiomata of the two pink studied forms and *P. djamor*, and also with the Japanese and Brazilian collections studied, according to the concept of the species discussed by Corner (1981), Pegler (1986) and Guzmán *et al.* (1993b). As for the cystidioid elements found in the two pink varieties, these correspond to the cheilocystidia considered by Guzmán *et al.* (1993b) in *P. djamor*, and agree with those cystidioid elements discussed by Guzmán *et al.* (1994) and Hilber (1982) in *Pleurotus ostreatus*-complex. However, the cheilocystidia observed in both pinkish varieties tend to be more widely-clavate than those found in *P. djamor* [(12.8-) 16-32 (-36) x (4-) 5-9 (-11) μm , Guzmán *et al.*, 1993b].

It is concluded that *P. djamor* presents two wild pink forms in Mexico, besides the typical whitish or beige form. One form has white spore print as the typical wild *P. djamor* and the other presents salmon color or pinkish-brown spore print, and the three are intercompatible. Under culture conditions, the pink form with salmon color or pinkish-brown spore print produces pink or

whitish forms with coloured or whitish spore print according illumination conditions. These two pink forms are considered as ecological varieties of *P. djamor*, as var. *roseus* (strain IE-134) and var. *salmonostramineus* (strain IBUG-7₅).

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A KEY TO THE GENUS *ALBUGO*

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SUMMARY

The descriptions of 40 species of *Albugo* (Pers.) S.F. Gray occurring on 23 plant families are summarised and presented as a key for identification and comparisons.

INTRODUCTION

Albugo (Pers.) S.F. Gray (Syn. *Cystopus* Lév., and pro parte *Uredo* Pers., *Erysibe* Theopr. ex Wallr., *Aecidium* Pers. and *Caeoma* Link) is the only genus belonging to the family Albuginaceae (Peronosporales, Oomycetes).

Albugo spp. are distributed world wide and cause the disease commonly known as "white rust" or "white blister" on a wide range of hosts. They produce characteristic cream-coloured blisters on leaves and sometimes on stems, which eventually erupt into white chalky pustules containing masses of sporangia. In some hosts galls are produced in stems, inflorescences and roots. Oospores of *Albugo* also form within leaf tissues but they occur more frequently in leaf veins, petioles, stems, buds and galls.

Biga (1955), recognised 33 species and nine varieties of *Albugo* but since then, many new species have been described. All of the species are thought to be host family specific, however, some have been described so briefly that there is often little or no apparent morphological distinction between them. The use of host family as the primary taxonomic character may prove not to be valid but until critical comparisons of the morphology, in particular oospore wall, together with cross-inoculation studies are carried out, it is not possible to say if all species of *Albugo* are distinctly different and that they are indeed host family specific.

General Morphology

The sporangiophores of *Albugo* are hyaline, clavate to cylindrical and bear sporangia in chains. The terminal sporangia are usually slightly larger, more globose, thick walled (2-4 μm thick) and the contents are often pale-yellow. The bulk of the sporangia, which we term "normal" are globose-cuboid to oval-cylindrical and the contents are usually hyaline. There appear to be three types of sporangial wall in *Albugo* :

- (1) Thin wall of uniform thickness, 1-2 μm .
- (2) Wall with internal equatorial thickening, 3-4 μm
- (3) Wall with thickening across the base and the sides.

The species of *Albugo* can also be divided into two groups according to the size of "normal" sporangia:

- (1) Sporangia 10-20 μm diam.
- (2) Sporangia 15-25 μm diam.

The size of oospores, sporangiophores and sporangia of *Albugo* are influenced by the nature of the host plants and climatic factors such as moisture (Togashi *et al.*, 1931; Makinen & Hietajarvi, 1965). Hence, the ornamentation of the oospore wall remains the critically important morphological character for distinguishing species of *Albugo*.

The oospores of *Albugo* are loosely enveloped by the thin oogonial wall even when fully mature. The oogonial wall may also have tuberculate thickenings or may form a firm envelope in some species, particularly in the Convolvulaceae. Oospores are usually globose to subglobose and the wall is approximately 4-8 μm thick. Although some oospores remain hyaline, most turn pale brown to dark brown on maturity. The wall is uniquely sculptured for each species, although it can be smooth in some. Hence, for any future revision of *Albugo*, close examination of the oospore wall using S.E.M. would be desirable.

The following key is based primarily on host plant family, sporangia and oospore morphology (cf. Biga, 1955). The synonymy of the *Albugo* spp. found in Biga (1955) is not repeated here. Several of the species described since Biga (1955) have not been included in the key but are included in discussion following the relevant families. References following each species are those used to compile the key.

KEY TO THE SPECIES

(1) on **Acanthaceae**

Sporangia with uniform wall thickness.

Sporangia 10-20 μm diam.

Oospores reticulate, 45-70 μm diam., brown.

A. acchmantherae Zhang *et* Y.X. Wang

Ref.: Zhang *et al.*, 1984.

Sporangia with equatorial wall thickening.

Sporangia 15-25 μm diam.

Oospores undescribed.

A. quadrata (Kalchbr. *et* Cooke) Kuntze

Ref.: Wakefield, 1927.

(2) on **Aizoaceae**

Sporangia 10-20 μm diam., with uniform wall thickness.

Oospores reticulate, areolae 6-15 (24) μm wide,
40-55 μm diam., dark-brown.

A. molluginis S.Ito

Ref.: Ito & Tokunaga, 1935; Mayor & Viennot - Bourgin, 1951;
Biga, 1955.

Sporangia 15-25 μm diam., with uniform wall thickness.

Oospores reticulate, areolae 3-6 μm wide,
50-80 μm diam., dark-brown.

A. trianthemae Wilson

Ref.: Wilson, 1908; Baker, 1955; Waterhouse, 1975.

Oospores densely papillate, 40-60 μm diam.

A. austro-africana Sydow

Ref.: Sydow & Sydow, 1912; Wakefield, 1927.

A revision of the species on the Aizoaceae was carried out by Waterhouse (1975).

(3) on **Amaranthaceae**

Sporangia with distinct equatorial wall thickening.

Sporangia 10-20 μm diam.

Oospores reticulate, areolae 6-8 μm wide,
45-75 μm diam., dark-brown.

A. bliti (Biv.) Kuntze

Ref.: Saccardo, 1888; Wilson, 1907; Wilson 1908;
Wakefield, 1927; Biga, 1955.

Sporangia with uniform wall thickness.

Sporangia 10-20 μm diam.

Oospores smooth, 75-90 μm diam., dark-brown.

A. gomphrenae (Speg.) Cif. et Biga

Ref.: Saccardo, 1912.

Sporangia 15-25 μm diam.

Oospores undescribed.

A. achyranthis (P. Henn.) Miyabe apud Ito et Tokunaya

Ref.: Sawada, 1922; Ito and Tokunaya, 1935.

(4) on **Apiaceae**

Sporangia 10-20 μm diam. with equatorial wall thickening

Oospores undescribed

A. hydrocotyles Petrak

Ref.: Petrak, 1955.

(5) on **Asteraceae**

Sporangia 15-25 μm diam., with equatorial wall thickening.

Oospores finely reticulate,

55-70 μm diam., dark-brown.

A. solivae Schröt.

Ref.: Hennings, 1896; Biga, 1955.

Oospores reticulate, areolae 1-2 μm wide,

45-75 μm diam., dark-brown.

A. chardiniae Bremer et Petrak

Ref.: Bremer & Petrak, 1947.

Oospores reticulate with ridges bearing spines,
areolae 2-4 μm wide,
40-70 μm diam., dark-brown.

A. tragopogonis (Pers.) S.F. Gray

Ref.: Wilson, 1907; Baker, 1955; Biga, 1955; Mukerji, 1975;

Several varieties of *A. tragopogonis* have been erected by Savulescu & Rayss (1930) and Biga (1955) based on host specialisation and apparent differences in size of sporangia. Whipps and Cooke (1978b) have suggested that physiologic race rather than varietal distinction be used in *A. tragopogonis*. The full nomenclature has been outlined by Whipps and Cooke (1978a)

(6) on **Boraginaceae**

Sporangia 15-25 μm diam.

Oospores reticulate, areolae 3-4 μm wide,
45-55 μm diam.

A. cynoglossi (Unamuno) Cif. et Biga

Ref.: Unamuno, 1930; Biga, 1955.

The status of *A. sibirica* (Zalew.) Wilson is unclear. Biga (1955) did not include it in his key and Wilson (1907) did not describe it.

(7) on **Brassicaceae**

Sporangia with uniform wall thickness, 10-20 μm diam.

Oospores verrucose with short ridges, 30-55 μm diam.,
dark-brown.

A. candida (Pers.) Kuntze

Ref.: Wilson, 1907; Biga, 1955; Mukerji, 1975; Zhang *et al.*, 1984.

Albugo candida has been divided into several forms by Savulescu & Rayss (1930) and two varieties (Biga, 1955). Host specificity has been demonstrated by Hiura (1930) and Eberhardt (1904). The division of *A. candida* into two varieties based on conidial size and host (Biga, 1955) i.e. var. *candida* and var. *macrospora* Togashi & Shibasake appears to be partly supported by Williams and Pound (1963) and Makinen and Hietajarvi (1965). The species *A. lepidii* Rao described from *Lepidium* (Rao, 1979) is synonymous.

(8) on **Capparidaceae**

Sporangia with uniform wall thickness, 10-20 μm diam.

Oospores tuberculate, 30-40 μm diam.

A. capparidis (de Bary) Cif.

Ref.: Saccardo, 1888; Biga, 1955.

Oospores verrucose with short ridges,
30-55 μm diam., dark-brown.

A. candida (Pers.) Kuntze

Ref.: Wilson, 1907; Biga, 1955; Mukerji, 1975; Zhang *et al.*, 1984

Sporangia with wall thickening across the base and sides,
10-20 μm diam.

Oospores undescribed.

A. chardoni Weston

Ref.: Chardon & Toro, 1930.

(9) on **Caryophyllaceae**

Sporangia with uniform wall thickness, 15-25 μm diam.

Oospores densely papillate - echinulate with short ridges,
50-65 μm diam., brown.

A. caryophyllacearum (Wallr.) Cif. *et* Biga

Ref.: Saccardo, 1888; Wilson, 1907; Biga, 1955.

(10) on **Chenopodiaceae**

Sporangia 10-20 μm diam.

Sporangia with equatorial wall thickening, contents yellow.

Oospores reticulate - foveate (i.e., shallowly pitted),
areolae approx. 2 μm wide,
40-70 μm diam., yellowish-brown.

A. occidentalis Wilson

Ref.: Wilson, 1907.

Sporangia 15-25 μm diam.

Sporangia with thin, indistinct equatorial wall thickening.

Oospores reticulate - tuberculate and echinulate,
35-60 μm diam., brown.

A. eurotiae Tranzsch.

Ref.: Saccardo & Trotter, 1926.

(11) on **Convolvulaceae**

Oogonial inner wall with plicate to tuberculate thickenings, light-brown, often appearing confluent with the oospore wall.

Sporangia with equatorial wall thickening.

Sporangia 10-20 μm diam.

Oospores 25-55 μm diam.

A. ipomoeae-panduranae (Schwein.) Swingle

Ref.: Wilson, 1907; Biga, 1955; Mukerji & Critchett, 1975; Singh & Bedi, 1965.

Oospores 30-45 μm diam.

A. minor (Speg.) Cif.

Ref.: Biga, 1955.

Oospores 35-55 μm diam.

A. ipomoeae-pescaprae Cif.

Ref.: Trotter, 1972.

Sporangia with uniform wall thickness.

Sporangia 10-20 μm diam.

Oospores 30-50 μm diam.

A. evolvuli (Damle) Cif. *et* Biga

Ref.: Damle, 1943; Safeeulla & Thirumalachar, 1953.

Oospores 22-28 μm diam.

A. pestigridis Gharse

Ref.: Gharse, 1964; Rao, 1964.

Sporangia 15-25 μm diam.

Oospores 30-40 μm diam., smooth, hyaline.

A. ipomoeae-hardwickii Sawada

Ref.: Sawada, 1927.

Oospores 35-50 μm diam., smooth, hyaline.

A. ipomoeae-aquaticae Sawada

Ref.: Sawada, 1922; Safeeulla & Thirumalachar, 1953; Ho & Edie, 1969.

Two varieties of *A. evolvuli*; var. *merremiae* Safeeulla and Thirum. (Safeeulla and Thirumalachar, 1953) and var. *mysorensis* Safeeulla (Safeeulla,

1952) and the species *A. pratapi* Damle (Damle, 1955) have been described on hosts in the Convolvulaceae. All appear to be synonymous with *A. evolvuli*.

The oospores of *A. ipomoeae-panduranae* and *A. ipomoeae-pescaprae* were described as papillate with irregular ridges and tuberculate respectively. However, we suspect that the tuberculate thickenings of the inner oogonial wall may have been misinterpreted as the oospore ornamentation. Both oospore wall and oogonial wall must be described accurately for any revision of the species on the Convolvulaceae.

(12) on **Crassulaceae**

Sporangia 15-25 μm diam., with wall thickening across the base and sides.

Oospores undescribed.

A. tilkeae (Lagerh.) Cif. et Biga

Ref.: Patouillard & de Lagerheim, 1891.

(13) on **Fabaceae**

Sporangia 10-20 μm diam.

Oospores undescribed.

A. mauginii (Parisi) Cif. et Biga

Ref.: Biga, 1955.

(14) on **Fumariaceae**

Sporangia 10-20 μm diam.

Oospores undescribed

A. keeneri Solheim et Gilbertson

Ref.: Solheim & Gilbertson, 1977.

(15) on **Gentianaceae**

Sporangia with equatorial wall thickening.

Sporangia 10-20 μm diam.

Oospores reticulate, 40-55 μm diam., deep-yellow.

A. swertiae (Berl. et Kom.) Wilson

Ref.: Saccardo & Trotter, 1912.

Sporangia with indistinct equatorial wall thickening.

Sporangia 15-25 μm diam.

Oospores closely reticulate, 50-60 μm diam., dark-brown.

A. centaurei (Hansf.) Cif. et Biga

Ref.: Hansford, 1954.

(16) on **Nyctaginaceae**

Sporangia with equatorial wall thickening, 15-25 μm diam.

Oospores reticulate, areolae 3-5 μm wide,

50-80 μm diam., dark-brown.

A. platensis (Speg.) Swingle

Ref.: Saccardo & Saccardo, 1905; Wilson, 1907; Spegazzini, 1909.

(17) on **Papaveraceae**

Sporangia with uniform wall thickness, 10-20 μm diam.

Oospores undescribed.

A. comeconis Zhang *et* Wang

Ref.: Zhang & Wang, 1981.

(18) on **Peperomiaceae**

Sporangia with uniform wall thickness, 15-25 μm diam.

Oospores verrucose, 30-40 (60) μm diam.

A. tropica (Lagerh.) Lagerh.

Ref.: Patouillard & de Lagerheim, 1892; Biga, 1955.

(19) on **Portulacaceae**

Sporangia with uniform wall thickness, 10-20 μm diam.,

contents pale-yellow.

Oospores reticulate with a spine in each areola,

areolae 8-12 μm wide, 40-70 μm diam., dark-brown.

A. portulacae (DC.) Kuntze

Ref.: Saccardo, 1888; Wilson, 1907; Wakefield, 1927;

Baker, 1955; Biga, 1955.

(20) on **Resedaceae**

Sporangia 10-20 μm diam.

Oospores verrucose, 45-60 μm diam.

A. resedae (Jacz.) Cif. *et* Biga

Ref.: Rayss, 1938; Biga, 1955.

(21) on **Scrophulariaceae**

Sporangia with equatorial wall thickening, 15-25 μm diam.

Oospores undescribed.

A. evansii Sydow

Ref.: Sydow & Sydow, 1912; Wakefield, 1927.

(22) on **Solanaceae**Sporangia 10-20 μm diam.

oospores undescribed.

A. hyoscyami Zhang, Y.X., Wang *et* Fu

Ref.: Zhang, Y.X., Wang & Fu, 1986.

(23) on **Urticaceae**Sporangia with uniform wall thickness, 10-20 μm diam.Oospores smooth - slightly wrinkled, 30-45 μm diam., pale-brown.**A. pileae** Tao *et* Y. Qin

Ref.: Tao & Qin, 1983.

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NEW SPECIES OF PERTUSARIA (LICHENISED ASCOMYCOTINA) FROM NEW ZEALAND, AUSTRALIA AND VENEZUELA

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ABSTRACT: The species *Pertusaria dissita* Elix & Archer, *Pertusaria duppensis* Archer & Malcolm, *Pertusaria elliptica* Müll. Arg. var. *bispora* Elix & Archer, *Pertusaria flavovelata* Elix & Malcolm, *Pertusaria murrayi* Elix & Archer, *Pertusaria scottii* Elix & Archer, *Pertusaria tapadensis* Elix & Archer and *Pertusaria vallicola* Elix & Malcolm are described as new. *Pertusaria tyloplaca* Nyl. is re-instated into the New Zealand lichen flora and the new name *Pertusaria clarkeana* Archer is proposed.

INTRODUCTION

The lichen genus *Pertusaria* in New Zealand was reviewed by Galloway (1985) and an account of the saxicolous species common to Australia and New Zealand, together with a key to the New Zealand saxicolous species, has been given (Archer & Elix 1993). More recently, the corticolous species have been revised and new species, together with a key to such species, have been published (Archer and Elix 1994). This paper reports additional new corticolous species from the South island of New Zealand, an additional new species and a new variety from Australia and a new muscicolous species from Venezuela. The techniques used for the examination of specimens have been described previously (Archer 1991a) and the chemistry of the specimens was confirmed by liquid chromatography (Elix & Venables 1993). The spore descriptions follow the nomenclature of Dibben (Dibben 1980:10). The figures illustrate the holotype specimens.

NEW SPECIES

Pertusaria dissita Elix & A.W. Archer, sp. nov.

Fig.1

Thallus flavo-viridis vel albo-olivaceus, areolatus et rimosus, superficies subtuberculata et hebetata, isidiis et sorediis destitutis; saxicola; apothecia verruciformia, dispersa, raro confluentia, plano-hemisphaerica, thallo concoloria, vulgo basibus constrictis, 0.8-1.5

mm diam.; ostiola inconspicua, nigra punctiformia, zona flavida opaca cincta 0.2 mm diam., in verrucis 1-2nis; sporae 8nae, irregulariter biseriatae, ellipsoideae, laeves, (60-)70-90(-105) μ m longae, 30-40(-45) μ m latae.
Thallus acida thiophaninica et stictica continens.

Type: Australia, Northern Territory, Mt McLachlan, 7 km NW of Pine Creek, on rocks along rocky slope in *Eucalyptus*-dominated woodland, 13°47'S, 131°47'E, alt. 200 m, *J.A. Elix* 28213, *H.T. Lumbsch & H. Streimann*, 20.vii.1991; ANUC-holotype.

Thallus dull yellowish green to pale olive green, areolate and cracked, surface subtuberculate and dull, lacking isidia and soredia; saxicolous; *apothecia* verruciform, conspicuous, scattered, rarely confluent, flattened-hemispherical, concolorous with the thallus, usually constricted at the base, 0.8-1.5 mm diam.; *ostiols* inconspicuous, black, punctiform, surrounded by a pale yellow opaque zone, ca. 0.2 mm diam., 1-2 per verruca; *spores* 8 per ascus, irregularly biseriate, ellipsoid, smooth, (60-)70-90(-105) μ m long, 30-40(-45) μ m wide.

Chemistry: K-, KC+ orange, C+ orange, Pd-; stictic acid(major), constictic and hypostictic acids (minor), cryptostictic, hypoconstictic and menegazziaic acids (traces), lichexanthone (trace to minor), thiophaninic acid (major), 2-chloro-6-*O*-methyl-norlichexanthone (minor) and 4-chloro-6-*O*-methylnorlichexanthone (trace).

Specimen examined:

Australia, Northern Territory, Green Ant Creek, 35 km SSE of Adelaide River Settlement, 13°31'S, 131°15'E, alt. 160 m, on rock in remnant forest in gully, *J.A. Elix* 28191, 19.vii.1991 (ANUC); *ibid.*, alt. 200 m, *H. Streimann* 48590, 19.vii.1991 (B, CBG 9108637).

Pertusaria dissita is characterised by the dull yellow-green thallus, asci with eight, predominantly biseriate spores and the presence of thiophaninic, stictic and hypostictic acids. It is the fertile, esorediate analogue of the sterile, sorediate *Pertusaria remota* Archer (Archer 1991a), and the two species form a "species pair", *sensu* Poelt (1970, 1972) as do the morphologically similar pair of species, *Pertusaria xanthoplaca* Müll. Arg. and *Pertusaria persulphurata* Müll. Arg. *Pertusaria dissita* resembles *Pertusaria xanthoplaca*, both morphologically and chemically, but the two species are distinguished by their distribution and distinctive colours. The new species has a more northerly distribution west of the Great Dividing Range whereas *Pertusaria xanthoplaca* occurs in eastern Australia east of the Great Dividing Range. Although the two species contain thiophaninic acid, *Pertusaria xanthoplaca* is bright yellow in contrast to the dull yellow-green colour of *Pertusaria dissita*. The new species is known only from the two localities cited above, in contrast to the sorediate analogue *Pertusaria remota* which occurs frequently in northern Western Australia and the Northern Territory (Archer 1991a). The epithet "dissita", remote, is selected to show the close relationship with *Pertusaria remota*.

***Pertusaria duppensis* A.W. Archer & Malcolm, sp. nov.**

Fig. 2

Thallus albo-hinnuleus, tenuis, continuus, superficies laevis et hebetata, isidiis et sorediis destitutus; corticola; apothecia disciformia, inconspicua, dispersa, immersa, grisea, translucens, margine nigro, 0.2-0.4 mm diam., discus epruinosis, nitidus; sporae 8nae, irregulariter 1- vel 2-seriatae, ellipsoideae, laeves, 33-41 μ m longae, 18-22 μ m latae, parietibus 2-4 μ m crassis.
Materia chemica in thallo non detecta.

Type: New Zealand, South Island, Nelson, Mt Duppa track, on *Griselinia littoralis*, 41°12'S, 173°29'E, alt. ca. 750 m, W. Malcolm 846, 23.v.1993; CHR 470260-holotype.

Thallus pale fawn, thin, continuous, surface smooth and dull, lacking isidia and soredia; corticolous; *apothecia* disciform, inconspicuous, scattered, immersed, pale grey, translucent, with a black margin, 0.2-0.4 mm diam.; surface of disc epruinose, shiny; *spores* 8 per ascus, irregularly 1- or 2-seriate, ellipsoid, smooth, 33-41 μ m long, 18-22 μ m wide, spore wall 2-4 μ m thick.

Chemistry: K-, KC-, C-, Pd-; no lichen compounds detected by tlc.

Pertusaria duppensis is characterised by the inconspicuous translucent discs and is distinguished from most other New Zealand species of *Pertusaria* by the absence of lichen compounds. It is distinguished from *Pertusaria sporellula* Archer & Elix (which also lacks lichen compounds) by the epruinose discs and the ellipsoid spores, whereas the spores are globular in *Pertusaria sporellula*.

Pertusaria duppensis is known only from the type specimen which was growing on the New Zealand endemic tree *Griselinia littoralis*; the species may therefore have a restricted distribution.

The epithet "duppensis" refers to Mt Duppa, the locality of the type collection.

***Pertusaria elliptica* Müll. Arg. var. *bispora* Elix & A.W. Archer, var. nov.**

Sicut *Pertusaria elliptica* Müll. Arg. sed asci bispori vice tetraspori et sporis parum majoris.

Type: Australia, New South Wales, beside Hacking River, ca. 37 km SSW of Sydney, 34°07'S, 151°03'E, alt. 10 m, on fallen branch, A.W. Archer P 265, 20.ii.1992; NSW-holotype.

Thallus off-white to pale greenish white, thin, somewhat cracked, surface smooth to subtuberculate and dull, lacking isidia and soredia; corticolous; *apothecia* veruciform, concolorous with the thallus, flattened-hemispherical, conspicuous, scattered, sometimes confluent, 0.6-1.2 mm diam.; ostioles conspicuous, black, 1 per verruca; *spores* 2 per ascus, ellipsoid, rough, (130-)140-175(-190) μ m long, 40-50 μ m wide.

Chemistry: K-, KC-, C-, Pd-; 2,5-dichlorolichexanthone (major), 2,4,5-trichlorolichexanthone (major), 2,4-dichlorolichexanthone (trace), 2-chlorolichexanthone (minor), 2-O-methylperlatolic acid (minor) and 2'-O-methylperlatolic acid (major).

Specimens examined:

Australia, New South Wales, type locality, A.W. Archer P 258, 31.i.1992 (NSW); Jerrawangla State Forest, Twelve Mile Road, near Boyd Lookout, 35°10'S, 150°23'E, alt. 500 m, on fallen branch, A.W. Archer P 325, 29.iii.1992 (NSW); Watagan State Forest, near German Point Road, ca. 38 km WSW of Newcastle, 33°04'S, 151°20'E, alt. 350 m, on dead branch, A.W. Archer P 685, 25.xi.1993 (NSW); Olney State Forest, ca. 5 km NNW of Cooranbong, 33°02'S, 151°25'E, alt. ca. 100 m, on tree by side of dry gully, A.W. Archer P 696, 20.xii.1993 (NSW).

The external morphology and chemistry of *Pertusaria elliptica* var. *bispora* are identical to those of var. *elliptica*; the two taxa differ in the number of spores per ascus (four per ascus in var. *elliptica*) and distribution. *Pertusaria elliptica* was originally reported to contain 4,5-dichlorolichexanthone (Archer 1991) but liquid chromatography has shown the presence of the xanthone mixture listed above. Var. *elliptica* occurs in eastern coastal

Australia as far south as Diamond Head, Crowdy Bay National Park, 30°09'S [Archer *P* 609 (NSW)] whereas var. *bispora* has a more southerly distribution and has not been found north of 33°02'S, see above.

***Pertusaria flavovelata* Elix & Malcolm, sp. nov.**

Fig. 3

Thallus cinereo-albus, tenuis, subrimosus, superficies laevis et hebetata, isidiis et sorediis destitutis; corticola; apothecia disciformia, conspicua, dispersa, 1-2 mm diam., epithecium initio celata margine thallino, hactenus findenti illud epithecium detegere; epithecium aureum, fulvescens, K+ rubescens; sporae singulae, ellipsoideae, laeves, 150-200 μ m longae, 45-55 μ m latae, parietibus 4-5 μ m crassis. Thallus acidum picrolichenicum continens.

Type: New Zealand, South Island, Mt Arthur, Flora Hut Road, 0.3 km W of Saddle, 41°11'S, 172°44'E, alt. 980 m, W. Malcolm 871, 13.v.1993; CHR 470261-holotype.

Thallus greyish-white, thin, somewhat cracked, surface smooth and dull, lacking isidia and soredia; corticolous; *apothecia* disciform, conspicuous, scattered, 1-2 mm diam., the epithecium initially concealed by the thalline margin, which then splits to reveal it; epithecium initially bright yellow, becoming dull yellowish grey, turning red with alkali; *spores* 1 per ascus, ellipsoid, smooth, 150-200 μ m long, 45-55 μ m wide, spore wall 4-5 μ m thick.

Chemistry: K-, KC+ violet, C-, Pd-; picrolichenic acid.

Pertusaria flavovelata is characterised by the dispersed disciform apothecia with bright yellow epithecium which become red with alkali, and the presence of picrolichenic acid.

Pertusaria flavovelata is known only from the type collection.

The epithet "flavovelata" refers to the initially concealed, bright yellow epithecium and to a resemblance to *Pertusaria velata*.

***Pertusaria murrayi* Elix & A.W. Archer sp. nov.**

Fig. 4

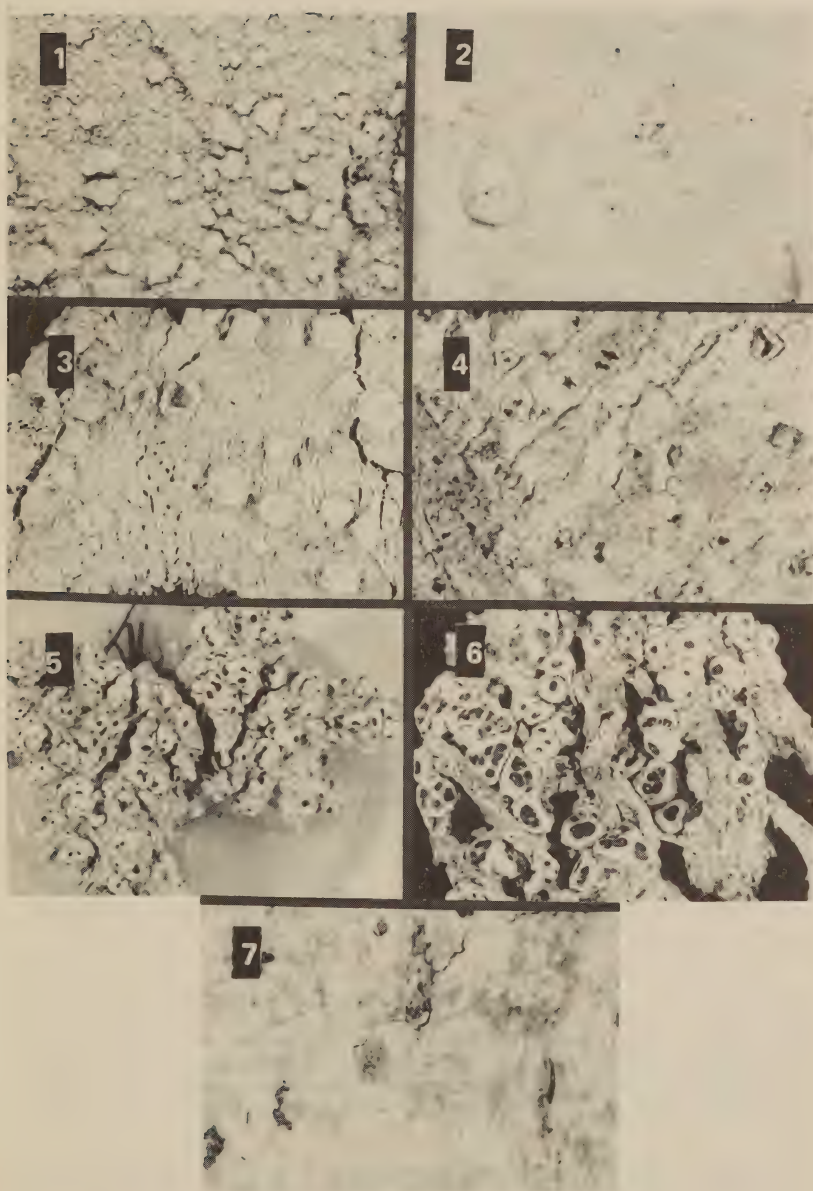
Sicut *Pertusaria celata* Archer & Elix sed bispori et acida salazinicum et norsticticum deficiens.

Type: New Zealand, South Island, Westland, Routeburn Hut, Routeburn Track, on beech trunk, J. Murray s.n., -i.1952; OTA 819-holotype.

Thallus off-white, areolate and cracked, surface smooth and dull, lacking isidia and soredia; corticolous; *apothecia* verruciform, inconspicuous, scattered, concolorous with the thallus, flattened hemispherical, not constricted at the base, 0.4-0.8 mm diam., becoming split and torn to reveal the black epithecium; *spores* 2 per ascus, ellipsoid, smooth, (125-)130-162 μ m long, 50-65 μ m wide.

Chemistry: K-, KC-, C-, Pd-; gyrophoric acid (major), lecanoric acid (trace), orcellinic acid (trace).

Pertusaria murrayi is characterised by the torn verrucae, revealing the epithecium of the apothecia below and in this respect resembles the corticolous New Zealand *Pertusaria celata* Archer & Elix (Archer & Elix 1994). However the new species is distinguished from *Pertusaria celata* by the two-spored asci and the absence of salazinic and norstictic acids. Gyrophoric acid was detected by liquid chromatography and its identity confirmed by mass spectrometry. The KC-ve and C-ve reactions of the thallus reflect the low concentration of gyrophoric acid present.



Figs. 1-7. New *Pertusaria* species. 1. *P. dissita*, X 3. 2. *P. duppensis*, X 4.
 3. *P. flavovellata*, X 2.6. 4. *P. murrayi*, X 4. 5. *P. scottii*, X 4.
 6. *P. tapadensis*, X 3.5. 7. *P. vallicola*, X 3.5.

The species is named after James Murray, 1923-1961, a New Zealand organic chemist and lichenologist, who collected the material cited above. The taxon is known only from the type specimen.

Pertusaria scottii Elix & A.W. Archer, sp. nov.

Fig. 5

Thallus cretaceus, superficies laevis et hebetata, isidiis et sorediis destitutis; crescens supra muscos et detritos varios vegetabilem; apothecia verruciformia, numerosa, conspicua, thallo concoloria, saepe confluentia et thallos tegentia, verrucae solitariae 0.4-0.6 mm diam.; ostiola conspicua, nigra, interdum depressa, in verrucis singula; sporae 8nae, ellipsoideae, laeves, praecipue uniseriatae, 44-55 μ m longae, 25-30 μ m latae. Thallus 4,5-dichlorolichexanthone et acidum 2-*O*-methylperlatolicum continens.

Type: New Zealand, South Island, Canterbury, Lake Tekapo, near Cass River, 2400 ft [730 m], in short tussock grassland, *D. Scott, s.n.*, 28.viii.1958; OTA 257-holotype.

Thallus chalky white, surface smooth and dull, lacking isidia and soredia; growing on plant debris and dead moss; apothecia verruciform, numerous, conspicuous, concolorous with the thallus, often confluent and covering the thallus, solitary verrucae 0.4-0.6 mm diam.; ostioles conspicuous, black, sometimes sunken, 1 per verruca; spores 8 per ascus, ellipsoid, smooth, predominantly uniseriate, 45-55 μ m long, 25-30 μ m wide.

Chemistry: K-, KC-, C-, Pd-; 4,5-dichlorolichexanthone and 2-*O*-methylperlatolic acid.

Pertusaria scottii is characterised by verrucae with conspicuous black ostioles, the eight-spored asci and the presence of 4,5-dichlorolichexanthone and 2-*O*-methylperlatolic acid. The smaller spores and the absence of stictic acid distinguish the new species from the New Zealand muscicolous *Pertusaria tyloplaca* Nyl., vide infra. The new species, which is named after the collector, D. Scott, is known only from the type specimen.

Pertusaria tapadensis Elix & A.W. Archer, sp. nov.

Fig. 6

Thallus albo-hinnuleus, subrimosus, superficies laevis et hebetata, isidiis et sorediis destitutis; crescens supra detritos varios vegetabilem; apothecia verruciformia, conspicua, thallo concoloria, saepe confluentia, plano-hemisphaerica, basi constricta, 0.6-1.0 mm diam.; ostiola nigra, conspicua, interdum depressa, 0.2-0.4 mm diam., in verrucis 1-3ne, interdum coalescentia; sporae 4nae (raro 3nae), uniseriatae, ellipsoideae, laeves, (125-)140-175 μ m longae, 40-60 μ m latae. Thallus 4,5-dichlorolichexanthone et acida 2-*O*-methylperlatolicum et sticticum continens.

Type: Venezuela, Sierra del Norte o de La Culata, Paramo de Los Conejos, Monte de La Laguna Tapada, 3450-3500 m, on dead moss, *M.L.Figueiras 23931*, 22.vi.1980. NSW-holo; herb. LUMBSCH-topo.

Thallus pale fawn, slightly cracked, surface smooth and dull, lacking isidia and soredia; growing over plant debris; apothecia verruciform, conspicuous, concolorous with the thallus, often confluent, flattened-hemispherical, becoming constricted at the base, 0.6-1.0 mm diam.; ostioles black, conspicuous, sometimes slightly sunken, 0.2-0.4 mm diam., 1-3 per verruca, up to 12 in confluent verrucae, sometimes fusing to form 1 large ostiole to 0.7 mm diam; spores 4 (rarely 3) per ascus, 1-seriate, ellipsoid, smooth, (125-)140-175 μ m long, 40-60 μ m wide.

Chemistry: K-, KC-, C-, Pd-; 4,5-dichlorolichexanthone (major), 2-*O*-methylperlatolic acid (major), stictic acid (major) with traces of constictic, cryptostictic and menegazziaic acids.

Pertusaria tapadensis is identified by the four-spored asci and the chemistry and these characteristics distinguish the new species from other four-spored muscicolous *Pertusaria* species, Table 1. The muscicolous *Pertusaria confundens* Nyl., from Colombia (Nylander 1863) has eight spores per ascus and contains 4,5-dichlorolichexanthone; it is thus distinct from *Pertusaria tapadensis*. The new species is known only from the specimens cited above.

The epithet "tapadensis" is derived from the type locality, La Laguna Tapada.

TABLE 1

MUSCICOLOUS *PERTUSARIA* TAXA WITH FOUR-SPORED ASCI

Taxon:	<i>P. tapadensis</i>	<i>P. quartans</i> Nyl.	<i>P. trochisea</i> Norm	<i>P. glomerata</i> (Ach.) Schaer.
Spore length (μm)	140-175	93-140 *	42-96#	50-180§
Chemistry:				
4,5-dichlorolichexanthone	+	+	+	-
stictic acid	+	+	+	-
2-O-methylperlatolic acid	+	-	-	-
norstictic acid	-	-	-	+

*Oshio (1968); Nylander reported 70-110 μm (Nylander 1890).

Dibben (1980:117); § *ibid.*:91

***Pertusaria vallicola* Elix & Malcolm, sp. nov.**

Fig.7

Thallus albidus, tenuis, rimosus, superficies laevis et hebetata, isidiis et sorediis destitutis; corticola; apothecia verruciformia, plano-hemisphaerica, saepe confluentia, thallo concoloria, 0.6-1 mm diam.; ostiola conspicua, cineracea, translucencia, subdepressa, in verrucis singula, 0.2-0.3 mm diam.; spores 2nae, ellipsoideae, parietibus exteris undulatis ("asper" sensu Dibben), 125-137 μm longae, 50-62 μm latae.

Thallus acidum hyperprotocetraricum continens.

Type: New Zealand, South Island, Lewis Pass, Nina Valley Terrace, 42°18'S, 172°23'E, alt. 700 m, on fallen *Nothofagus* branch, W. Malcolm 368, 2.ii.1993; CHR 470259-holotype.

Thallus off-white, thin, cracked, surface smooth and dull, lacking isidia and soredia, corticolous; *apothecia* verruciform, flattened-hemispherical, often confluent, concolorous with the thallus, 0.6-1 mm diam.; *ostioles* conspicuous, pale grey, translucent, slightly sunken, 1 per verruca, 0.2-0.3 mm diam.; *spores* 2 per ascus, ellipsoid, rough, 125-137 μm long, 50-62 μm wide.

Chemistry: K-, KC-, C-, Pd-; hypoprotocetraric acid (major), virensic acid (trace) and convirensic acid (trace).

Specimen examined:

New Zealand, South Island, North Canterbury, Lewis Pass, Nina River, alt 2200 ft. [ca. 700 m], on *Nothofagus cliffortioides*, *C. D. Muerk s.n.*, 11.ix.1981 (CHR 402853).

Pertusaria vallicola is characterised by the flattened verrucae, two rough spores per ascus and the presence of hypoprotocetraric acid. This compound has not been reported previously from the genus *Pertusaria* although the related compounds, protocetraric and virensic acids, occur in *Pertusaria thwaitesii* Müll. Arg. and *Pertusaria virensica* R.C. Harris respectively. *Pertusaria vallicola* is known only from two specimens from the same locality.

The epithet "vallicola", dwelling in valleys, refers to the type locality, Nina valley.

NEW REPORTS

Pertusaria tyloplaca Nyl. *Lich.. Nov. Zel.*: 71 (1888).

C. r. hebd. Seanc. Acad. Sci. Paris 88: 90 (1878).

Type: New Zealand, Campbell Island, *H. Filhol, s.n.*, 1874; H-NYL 23600-holotype.

Thallus off-white, thin, surface smooth and dull, lacking isidia and soredia, growing on dead moss; *apothecia* verruciform, conspicuous, subspherical, concolorous with the thallus, scattered, sometimes confluent, 0.5-1 mm diam.; *ostioles* pale brown to translucent, 1 per verruca; *spores* 8 per ascus, biseriate, smooth, ellipsoid to subfusiform, (80-)95-120 μ m long, 30-40 μ m wide.

Chemistry: K?weak yellow, KC-, C-, Pd -; stictic acid (major), α -acetylconstictic acid (minor), menegazziaic acid (minor) and constictic acid (trace).

Specimen examined:

New Zealand, South Island, Mt Peel, South Canterbury, *D.J. Galloway s.n.*, -i.1972 (CHR 408314).

Pertusaria tyloplaca was not included in the Lichen Flora of New Zealand (Galloway 1985) and a description has therefore been given here. The species is characterised by the muscicolous habitat, the verruciform apothecia with eight biseriate spores per ascus, and the presence of stictic acid. It is distinguished from the muscicolous *Pertusaria scottii* (see above) by chemistry and spore size. Externally, *Pertusaria tyloplaca* resembles the bipolar *Ochrolechia xanthostoma* (Somm.) Lumbsch & Schmitz [*Pertusaria xanthostoma* (Somm.) Fr.] but the two species are readily distinguished by the spore number (four per ascus in *Ochrolechia xanthostoma*) and chemistry; the *Ochrolechia* species reacts KC+ red, C-, due to the presence of alektoronic acid.

NEW NAME

Pertusaria clarkeana A.W. Archer, nom. nov.

= *Pertusaria confusa* Archer, *Mycotaxon* 41: 224a (1991), non A. Zahlbruckner, *Cat. Lich. Univ.* V: 134 (1928).

Type: Australia, Queensland, Clarke Range, 46 km SSW of Proserpine, in rainforest on *Argyrodendron trifoliatum*, 20°49'S, 148°29'E, *H. Streimann* 37465, 29.vi.1986; CBG-holotype; B-isotype.

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**GLOMALES OF TAIWAN:
V. *GLOMUS CHIMONOBAMBUSAE* AND *ENTROPHOSPORA*
KENTINENSIS, SPP. NOV.**

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KEY WORDS: *Glomus*, *Entrophospora*, bamboo, taxonomy

ABSTRACT

Two new species of Glomales are described. *Glomus chimonobambusae* was isolated from the highland of Central Taiwan associated with bamboo, *Chimonobambambusa quadrangularis*, and *Entrophospora kentinensis* was recovered from the rhizosphere of native grass in Southern Taiwan.

Recently, interest on the application of arbuscular mycorrhizal fungi to grow horticultural plants has been increasing in Taiwan. Growers are eager to know how to use these biofertilizers, and ask for more inoculum which they believe will be helpful in the promotion of crop yield. Both massive production of spores for inoculation and collection of various arbuscular mycorrhizal fungi for inoculum are key steps in the

development of this biofertilizer. For these purposes, an extensive investigation of Glomales in Taiwan has been conducted to collect a variety of species from natural reservation areas using wet-sieving and decanting (Gerdemann and Nicolson, 1963). The sievings were further purified by sucrose centrifugation (Jenkins, 1964). Spores or sporocarps were propagated in the green house with bahia grass, green onion, leek or other host plants. For taxonomic study, spores were mounted in Hoyer's medium and made into semipermanent slides. Some collections were also preserved in FAA fixative.

A previous survey of Glomalean fungi in bamboo vegetation (*Phyllostachys pubescens* Mazel) in Taiwan revealed several undescribed species (Wu, 1983; Wu and Chen, 1986; 1987). Further study of that area resulted in the discovery of two new species that are described here. Holotype specimens are deposited in the Soil Microbiology Lab, Agricultural Chemistry Department, Taiwan Agricultural Research Institute, Wu-feng, Taichung, Taiwan, R.O.C. and isotypes in the Mycological Herbarium, Department of Plant Pathology, University of Florida, Gainesville, Florida, U. S. A.

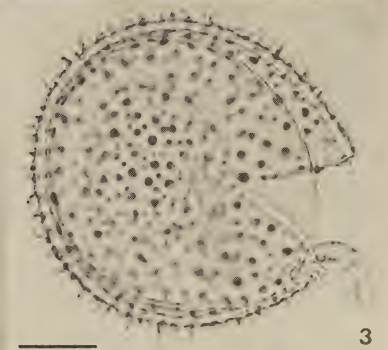
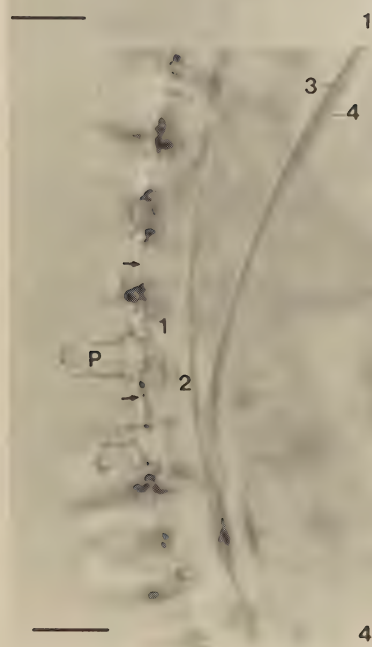
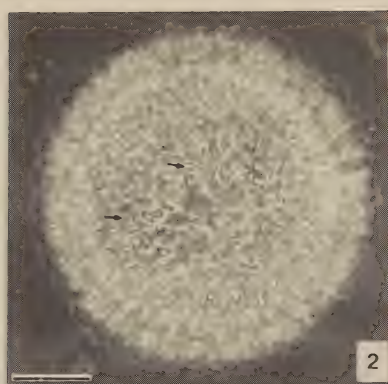
SPECIES DESCRIPTIONS

GLOMUS CHIMONOBAMBUSAE Wu and Liu , *sp. nov.*

Figs. 1-5, 16

Sporae subhyalinae vel albae, singulatae in solo, globosae, subglobosae, 110-180 μm diametro, vel obovatae, ellipsoidae, triangulatae, irregulares, 120-180 x 130-200 μm . Sporae pagina tecta a verrucis minutis et projecturis grossis, clavatis usque ad 12 μm longas. Sporae tunica e stratis quatuor: exteriore 3.5-4.5 μm crasso, secundo 1.5-2 μm crasso, tertio <0.5 μm crasso adhaerenti arte ad tunicam

Figures 1-5. Micrographs of *Glomus chimonobambusae*. Fig. 1. A chlamydospore and its blunt projections (scale bar = 40 μm). Fig. 2. Outer spore wall not only ornamented by long projections but also by minute warts (arrows) (scale bar = 40 μm). Fig. 3. A broken spore showing two wall groups (scale bar = 40 μm). Fig. 4. Crushed spore showing four walls. Note wall 1 decorated by blunt projections (P) and minute warts (arrows) (scale bar = 8 μm). Fig. 5. A warted attachment hypha and a slender branch (arrowhead) (scale bar = 20 μm)



quartum, quarto, 1.5 µm crasso, in iodo rubro subroseo. Mycorrhizae vesicular-arbusculares formans.

Spores subhyaline or white, borne singly in the soil, globose, subglobose, obovoid, triangular, or irregular. Globose or subglobose spores, 110-180 µm diam.; obovoid, ellipsoid, or irregular spores, 120-180 x 130-200 µm. Spore surface covered by tiny warts and coarse, clavate projections up to 12.5 µm long. Spore wall distinguished by two groups, four layers. Wall 1, ornamented by warts and projections, laminated, 3.5-4.5 µm thick; wall 2, a unit wall, closely adherent to wall 1, 1.5-2 µm thick; wall 3, <0.5 µm thick, a unit wall, closely attached to wall 4; wall 4, a unit wall, 1.5 µm thick. Attachment hypha subhyaline or white, 8-16 µm diam, tubular, constricted at the attachment. Some hyaline, fragile hyphal branches, 1-1.5 µm diam., formed along attachment hypha 30-45 µm below the spore base. Attachment occluded by wall thickening. Wall of attachment hypha warted for some distance below the attachment, 1-2 µm thick. Reaction to Melzer's reagent, wall 1 and wall 2, yellow, and wall 4, pinkish red. Reaction to lactophenol cotton blue reagent, spore walls all cyanophilous. Germination tube directly penetrating through the spore wall.

COLLECTIONS EXAMINED: TAIWAN: Nan-Tou, Chi-tou Experimental Station. **HOLOTYPE:** From the rhizosphere of *Chimonobambusa quadrangularis* (Fenzi) Makino, Wu-82041201(TARI). **ISOTYPE:** From the rhizosphere of the same host, Wu-82040101 (TARI). *Glomus scintillans* Rose and Trappe, from the rhizosphere of *Cercocarpus ledifolius* L., Lake Co., Oregon (OSU # 41,352).

HABITAT: Hypogeous. Spores were isolated from the bamboo garden in Chi-tou Experimental Station, National Taiwan University. The spores of *Glomus chimonobambusae* were isolated together with the spores of *Acaulospora elegans* Trappe & Gerdemann, *A. rehmii* Sieverding & Toro, *Glomus etunicatum* Becker & Gerdemann, and *Entrophospora infrequens* (Hall) Ames & Schneider.

ETYMOLOGY: Latin, *chimonobambusae* refers to the genus name of the host (*Chimonobambusa quadrangularis*), from the rhizosphere of which the spores were recovered.

NOTES: *Glomus chimonobambusae* is distinguished from other species of *Glomus* by its magnificent ornaments on the spore wall. The morphology of the attachment hyphae of the present species is very similar to *Glomus constrictum* Trappe (1977). The attachment hypha is often constricted at the attachment. Some hyaline, fragile hyphal branches, beyond the attachment, are frequently formed from the inflated attachment hypha. Sometimes, a septum is formed in the inflated hypha. The spore surface of *Glomus multicaule* Gerdemann & Bakshi is also covered by rounded projections; however, they are much shorter than those of *G. chimonobambusae*. The spores of *G. scintillans* Rose & Trappe (1980) are very similar to *G. chimonobambusae*. However, the former species differs in (i) having shorter hyaline knobs ($<2\ \mu\text{m}$) on the outer wall and without long projections, (ii) having smooth straight attachment hyphae, (iii) showing different reaction with Melzer's reagent. *Glomus dominikii* Blaszkowski (1988) is also similar to *G. chimonobambusae* producing white chlamydospores. But they are different in wall structure and ornamentation on the spore surface and attachment hyphal wall.

The ornamentation of spores of *G. chimonobambusae* is strikingly similar to that of *Scutellospora dipapillosa* (Walker & Koske) Walker & Sanders (Koske and Walker, 1985). Outer walls of spores of both species are covered with densely crowded, small, conical warts and more distantly spaced hyaline, blunt, larger projections.

ENTROPHOSPORA KENTINENSIS Wu and Liu, *sp. nov.*

Figs. 6-16

Sporae singulae in solo vel radicibus; sporae intra hypham subattenuatum gestae, cum terminatione inflata globosa, subglobosa, 100-150 μm diam; Sporae primo subhyalinae deinde cum lutiolo ad auream, globosae, subglobosae, ellipsoideae, irregulares, 85-140 x 95-210 μm ; sporae tunica e stratis sex: exteriore hyalino, caduco, 0.5-2 μm crasso; secundo fulvo ad aureobruneam, scrobiculato, 1.5-3 μm crasso, laminato; tertio inseparabilis e tunicae quartae, ca. 1 μm crasso; quinque hyalino, coriaceo, interdum minute asperulo vel rugoso, (1.5-)2-7.5(-12.5) μm crasso, in iodo rubropurpurascens; interiore amorpho, adhaerenti ad tunicam quintam, raro manifesto. Mycorrhizae vesicular-arbusculares formans.

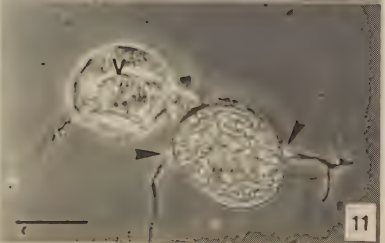
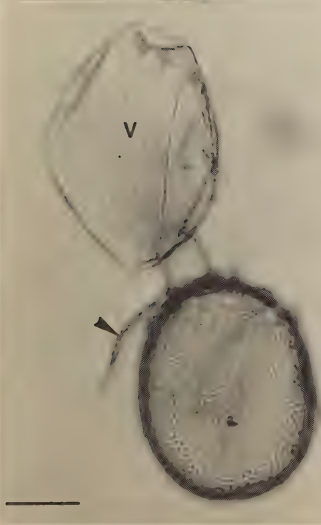
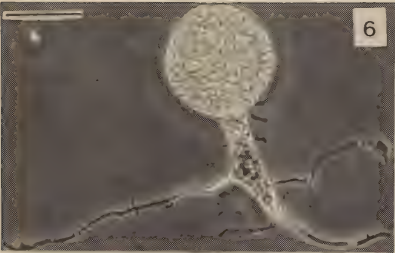
Spores produced singly in soil or in roots; spores formed within a slightly tapering hypha, terminating in a globose, subglobose swollen tip, 100-150 μm diam; hyphal terminus white to subhyaline, becoming transparent as contents empty to form a spore. Spores at first white to subhyaline becoming pale yellow to yellow brown at maturity, globose, subglobose, ellipsoidal, irregular, 85-140 x 95-210 μm .

Spore walls separated in two groups. In A group, wall 1, hyaline, confluent with the wall of hyphal stalk, ephemeral, 0.5 μm thick; wall 2, yellow-brown, laminated, ornamented with pits, 1.5-3 μm thick; pits on wall 2, 1-3 μm diam, separated by ridges (2-)-3-4(-6) μm ; wall 3 and wall 4, unit walls, ca. 1 μm thick, closely adherent together by amorphous cementing material. In B group, wall 5, hyaline, a coriaceous wall, (1.5-)2-7.5(-12.5) μm thick, minutely roughened or wrinkled in Hoyer's mounting medium, turning red-purple in Melzer's reagent; wall 6, amorphous, closely associated with wall 5, not often visible.

Site of the connecting hyphal attachment from the hyphal terminus frequently visible on the mature spore, 20-32.5 μm diam; the site of connecting hyphal attachment from the hyphal stalk, visible only on the newly-formed spore, 5-6 μm diam. Spores often attached with empty hyphal terminus in soil, having a dumbbell shaped configuration. Forming typical arbuscular mycorrhizae.

COLLECTIONS EXAMINED: HOLOTYPE: Maintained in pot culture of *Paspalum notatum* Flügge (culture no. SM-22) at Taiwan Agricultural Research Institute, Wu-feng, Taichung. Originally observed and collected from the rhizosphere of *Eleusine indica* (L.) Gaertn., Wu-82010612 (TARI) at Troun-feng-shii, National Ken-tin Park, Ping-tong; from the rhizosphere of *Setaria viridis* (L.) Baeuv., Wu-820613 (TARI), at Ser-Ding, National Ken-tin Park, Ping-tong; from the rhizosphere of *Eleusine*

Figures 6-11. Micrographs of *Entrophospora kentinensis*. Fig. 6. A sporiferous saccule (scale bar = 80 μm). Fig. 7. A developing spore (S) within the stalk of saccule (V) (scale bar = 40 μm). Fig. 8. Cytoplasm condensation within the stalk of saccule (arrowheads) (scale bar = 40 μm). Fig. 9. Collapsed hyphal terminus and mature spore (scale bar = 40 μm). Fig. 10. Separable, hyaline outer wall (arrowhead) of spore and collapsed hyphal terminus (V). Note the pitted spore (scale bar = 40 μm). Fig. 11. Spore with a collapsed hyphal terminus (V) and two connecting hyphal stalks (arrowheads) (scale bar = 80 μm).



indica, Wu-820401 (TARI), at Jen-der, by the bank of Er-Jen river, Tainan. The specimen was also found from Japan, collected by Dr. James Trappe in river bank sand under grasses, OSC# 38,840.

ETYMOLOGY: Latin, *kentinensis* refers to the locality where *E. kentinensis* was first isolated.

DISTRIBUTION: *Entrophospora kentinensis* was only found in two places of Southern Taiwan, National Ken-tin Park, Ping-Tong and a deserted lawn by Er-Jen river, Jen-der, Tainan.

NOTES: Spores of *Entrophospora kentinensis* resemble those of *Acaulospora scrobiculata* Trappe (1977) in color, ornamentation, and size. However, *E. kentinensis* differs from *A. scrobiculata* in (i) spore wall structure, (ii) spore ontogeny, and (iii) size and number of circatrics (Table 1).

Entrophospora kentinensis can survive in wide pH range, if compared with the other species of *Entrophospora* in Taiwan (Table 2). Most *Entrophospora* species exist in acidic soil.

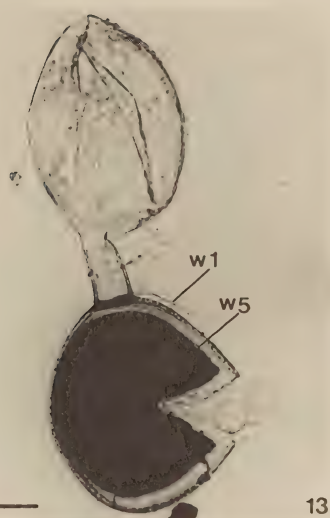
ACKNOWLEDGMENT

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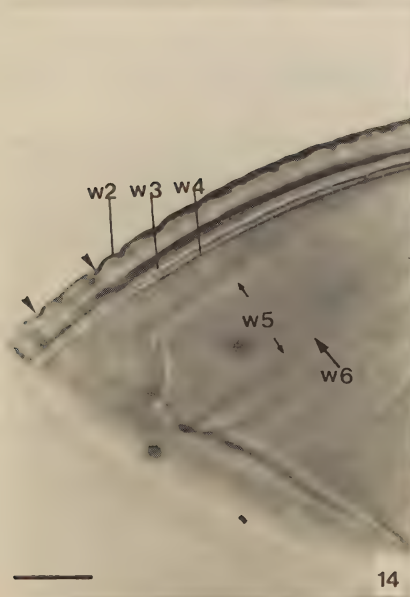
Figures 12-15. Micrographs of *Entrophospora kentinensis*. Fig. 12. A fractured spore showing two wall groups (scale bar = 40 μ m). Fig. 13. Wall 5 (W5) stained red-purple in Melzer's reagent. Note a piece of wall 1 (W1) attached with sporiferous saccule (scale bar = 40 μ m). Fig. 14. Close up of wall layers (numbered as in the description and micrograph). Note wall 2 (W2) ornamented with pits (arrowheads) (scale bar = 8 μ m). Fig. 15. Wall 1 (W1) connected with collapsed sporiferous saccule (scale bar = 20 μ m).



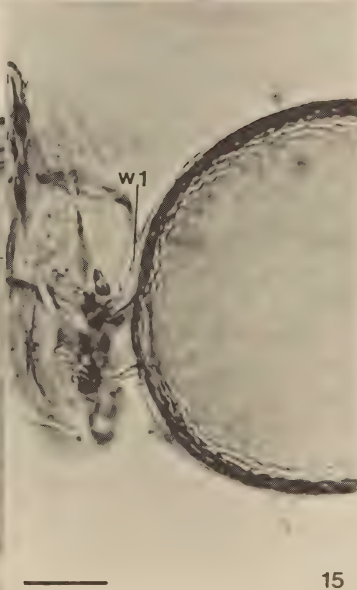
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Figure 16. Murographs of *Glomus chimonobambusae* and *Entrophospora kentinensis*.

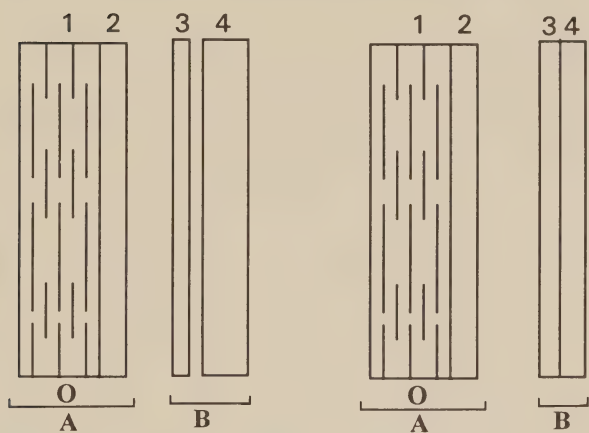
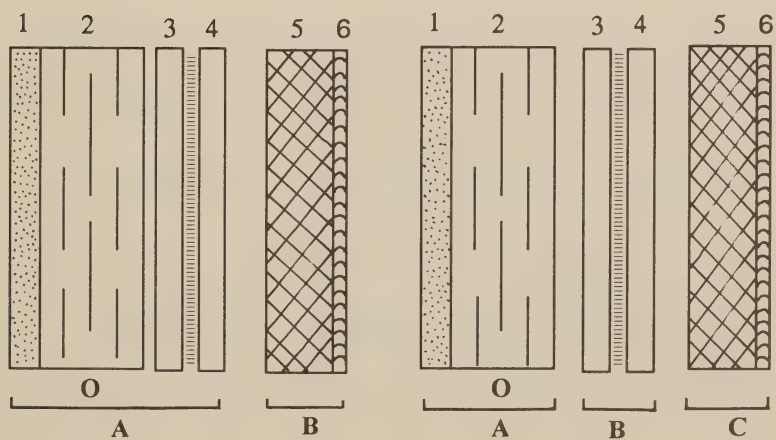
GLOMUS CHIMONOBAMBUSAE*ENTROPHOSPORA KENTINENSIS*

Figure 16

Table 1. Comparison of morphological features between *E. kentinensis* and *A. scrobiculata*.

Species	<i>Entrophospora kentinensis</i>	<i>Acaulospora scrobiculata</i>
Characters		
Wall layers	wall 1, 0.5 μm (E) wall 2, 1.5-3 μm (L,O) wall 3, <0.5 μm (U) wall 4, <0.5 μm (U) wall 5, 1.5-12.5 μm (C) wall 6, <0.5 μm (A)	wall 1, 3-6 μm (L,O) wall 2, 0.2-0.5 μm (U) wall 3, 0.5-1 μm (U) wall 4, 0.2-1 μm (U)
Reaction to Melzer's reagent	wall 5 & 6 reddish purple	wall 4 deep red
Spore ontogeny	Formed within stalk of hyphal terminus	Formed laterally on stalk of hyphal terminus
Circatrices	2-3, one 20-32.5 μm diam; the others 5-6 μm diam	one, ca. 15 μm diam
Remark: C: coriaceous wall, E: ephemeral wall, L: laminated wall, A: amorphous wall, U: unit wall, O: ornamented		

Table 2. pH range of soil from which spores of *Entrophospora* are isolated in Taiwan

Taxa	<i>Entrophospora columbiana</i>	<i>Entrophospora infrequens</i>	<i>Entrophospora kentinensis</i>
pH	2.71-4.4	3.12	5.71-7.94

WHAT IS *MYROTHECIUM PRESTONII*?

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Myrothecium prestonii is shown to be heterogeneous. A *sensu stricto* concept based on two collections is adopted for the species. Other collections assigned to this species are redispersed as *Hymenopsis olivacea* anam.-sp. nov. and *Stilbella* sp. *Hymenopsis bambusae* anam.-sp. nov. is described from a collection from India.

The mycological literature contains many examples of overly broad generic and species concepts. Often such broad concepts prevent, rather than facilitate, identification of subsequent collections. The problem of identification of a collection is further compounded when the description of the species is ambiguous; when unrelated specimens form the basis for the species concept; and when the specimen that served as the basis for a published illustration is not clearly indicated. Tulloch's (1972) treatments of the genus *Myrothecium* Tode : Fries, and species such as, *Myrothecium prestonii* Tulloch, exemplify these situations.

Tulloch (1972) adopted an extremely broad generic concept, making a most unfortunate choice - the colour of the conidial mass - as the overriding character unifying diverse species

possessing a variety of sporodochial, synnematosus and cupulate conidiomata (with or without conidiomatal setae), and conidia with or without mucoid appendages. Nag Raj (1993) advocated a *sensu stricto* concept of the genus and redispersed *M. atroviride* (Berkeley & Broome) Tulloch, *M. leucotrichum* (Peck) Tulloch, and *M. gramineum* Libert in *Hymenopsis* Saccardo, *Xepicula* Nag Raj and *Xepiculopsis* Nag Raj respectively (for distinctions between these anamorph-genera, see Nag Raj 1993).

Tulloch (1972) based her account of her new species, *M. prestonii* on six collections including IMI 160372, which she designated as the holotype collection. I have examined all but one of the collections and my observations are presented below.

The type specimen (Figs. 1 A-H; 3) and IMI 34466 carry an identical fungus. The conidiomata are sporodochial with white floccose, sparsely setose margins and a greenish black to black, glutinous conidial mass. Conidiomatal setae (Figs. 1 C,D; 3A) are subcylindrical, unbranched, straight or slightly bent, many-septate, colourless, thin- and smooth-walled toward the base, becoming progressively darker to olivaceous, thick-walled and tuberculate in the upper part. The conidiophores (Figs. 1 B,H; 3B) are branched, septate, and loosely packed. The conidiogenous cells are monophialidic with a distinct flaring collarette (Figs. 1 E,H; 3B). The conidia (Figs. 1 F,G; 3C) are asymmetrically fusiform to ellipsoid, unicellular, pale olivaceous, and possess a funnel-shaped or fan-shaped, mucoid apical appendage. This is a good *Myrothecium* sensu Nag Raj (1993) and is discussed below.

IMI 88728 bears a different fungus, the morphological features of which are illustrated in Figs. 2 A-I, and 4. The conidiomata are synnematosus and capitate (Fig. 2A), bearing a dark green,

agglutinated mass of conidia. The stipes are whitish to pale green, clothed in short, sterile elements arising as branches of the core hyphae (Fig. 2B). The terminal cells of the sterile elements are cylindrical to subcylindrical with rounded apices and ornamented with small tubercles (Fig. 2I). Occasional unbranched, straight or slightly bent setae are present (Figs. 2 C,E; 4A). These are sparsely septate, usually thin-walled, colourless and smooth in the lower part, thick-walled in the median part, becoming progressively almost colourless to pale olivaceous and slightly verruculose toward the apex where the wall is relatively thinner. The conidiophores are densely packed and fused below (Figs. 2 D,F; 4C). Conidiogenous cells are monophialides with minute periclinal thickenings, and colourless (Figs. 2 D,F; 4C). The conidia (Fig. 2 G,H; 4D) are ellipsoidal, unicellular, pale olivaceous, smooth, and have no mucoid appendage. This specimen does not belong in *Myrothecium*.

Another collection included by Tulloch under *M. prestonii* is housed in Herb. K as *Chaetostroma* sp. The fungus produces scattered, subcuticular, cupulate, marginally setose conidiomata (Fig. 5A), with a black centre and greyish green margins. The marginal excipular elements are incurved, composed of unbranched and densely aggregated olivaceous hyphae with swollen apical cells (Fig. 5D). The conidiomatal setae (Fig. 5B) are subulate, unbranched, thick-walled, with many thin septa, colourless to pale olivaceous, smooth-walled. The conidiophores (Fig. 5C), arising from the basal stroma, are compact, septate, branched. The conidiogenous cells (Fig. 5C) are phialidic with periclinal thickenings and flaring collarettes, smooth-walled, colourless below but pale olivaceous near the collarette. The conidia (Fig. 5E) are fusiform to ellipsoidal with an acute to blunt apex and a narrow, truncate base, unicellular, olivaceous

green, without an appendage. This specimen is not a *Myrothecium*.

IMI 51710(e) on leaves of *Neuboldia laevis* from Sierra Leone is sterile. I have not been able to examine IMI 78650.

From the foregoing accounts, it is apparent that *M. prestonii* as circumscribed by Tulloch (1972) is a mixture of three different taxa.

1. Only IMI 160372 and IMI 34466 are acceptable as *Myrothecium prestonii*.

2. The synnematos nature of the conidiomata of IMI 88728, the ornamented stipe cells, and the enteroblastic-phialidic mode of conidium development suggest an affinity with *Stilbella* Lindau (Seifert 1985), though the presence of occasional conidiomatal setae is unusual.

3. The fungus with cupulate conidiomata occurring on *Thea* sp. has been disposed in herb. K as an undetermined species of the genus *Chaetostroma* Corda, whose status is shrouded in doubt. As indicated by Sutton (1977), this anamorph-genus with the original species *C. carmichaelii* Corda and *C. isabellinum* Corda, is not formally typified. He designated *C. carmichaelii* as the lectotype species. Tulloch (1972), however, states that type material is not available, that the original illustration depicts two types of conidia, and that the description is inadequate to identify the genus. For these reasons, she advocated rejection of the generic name by invoking Article 70 of the ICBN. The fungus in K, however, has features that conform to the accepted generic concept of *Hymenopsis* (Sutton 1980, Nag Raj 1993).

The problems associated with Tulloch's (1972) treatment of *M. prestonii* can be overcome by adopting a narrow concept for the species. The relevant taxa are redescribed below. One of my

collections from India forms the basis for a new species of *Hymenopsis*.

Myrothecium prestonii Tulloch

Figs. 1 A-H, 3

Mycol. Pap. 130: 12, 1972.

Conidiomata sporodochial, scattered to gregarious and confluent, pulvinate, orbicular to irregular in outline, 250-300 μm diam., 80-160 μm high, with white floccose, sparsely setose margins; basal stroma poorly developed; conidial mass greenish black to black, glutinous; setae subcylindrical, with a blunt or rounded apex, unbranched, straight or slightly bent, many septate, colourless, thin-walled and smooth, 2-2.5 μm wide below, becoming progressively darker to olivaceous, thick-walled and tuberculate, and 3.5-4.5 μm wide in the upper part, 2-3.5 μm wide at the apex, up to 200 μm long. *Conidiophores* branched, loosely packed, septate, smooth-walled to slightly verruculose in the lower part, up to 100 μm long. *Conidiogenous cells* phialidic, subcylindrical with flaring collarettes, usually in terminal clusters of up to 9 in a loosely packed palisade, olivaceous, smooth, 11-16 X 1.5-2 [$\bar{x}$ = 13.2 X 1.7] μm . *Conidia* fusiform to ellipsoid, but asymmetrical with a slightly curved acute apex and a narrow truncate base, unicellular, pale olivaceous, smooth, 4-7 X 2-2.5 [$\bar{x}$ = 5.6 X 2.2] μm , with a funnel-shaped or fan-shaped, mucoid apical appendage; mean conidium length/width ratio = 2.5:1.

Habitat: Known from agar culture isolated from soil and from *Oryza sativa*.

Specimens examined: 1) IMI 160372 [Holotype], isolated from forest soil, Ulu Gombak, Selangor, Malaysia, 1971, Wong Heng Tong; 2) IMI 34466, isolated from *Oryza sativa*, Federal Exp. Stn., Serdang, Malaysia. comm. A. Johnston, 15.III.1949.

Known distribution: Malaysia.



Figure 1. *Myrothecium prestonii* ex IMI 160372. A. Vertical section of conidioma. B, E & H. Conidiophores and conidiogenous cells. C. & D. Conidiomatal setae. F. Conidia in lactic acid mount. G. Conidia in aqueous mount. (A - ca X 150; B & C - ca X 600; D-H - ca X 1500).

Myrothecium prestonii is similar to *M. verrucaria* (Albertini & Schweinitz) Ditmar, the only species of *Myrothecium* with appendage-bearing fusiform conidia, but differs from it in its setose sporodochia and in its narrower, asymmetrical conidia. *M. inundatum* Tode : Gray, is the only other species of *Myrothecium* which has sporodochia with setae. It differs from *M. prestonii* in its setae which have irregularly thick, smooth walls, a lumen of irregular width, a median part wider than the narrow extremities. Its conidia are smaller, short cylindrical with a blunt or rounded apex and a narrow base, and lack the mucoid apical appendage typical of *M. prestonii*.

Stilbella sp.

Fig. 2 A-I, 4 A-D

Conidiomata hypophyllous, scattered, synnematosus, with a head of dark green agglutinated conidia and a white to pale green stipe, 90-170 μm long, 40-70 μm wide, clothed in short, sterile elements arising as branches of the core hyphae, with cylindrical to subcylindrical terminal cells rounded at the apex and ornamented with small tubercles, colourless to pale olivaceous, 2-3 μm wide; conidiomatal setae sparse, straight or slightly bent, up to 4-septate, usually thin-walled, colourless, smooth in the lower part, thick-walled in the median part, changing progressively from almost colourless to pale olivaceous and somewhat verruculose toward the apex, 100-200 μm long, 2.5-3 μm wide at the base, 4-6 μm wide in the apical part. *Conidiophores* densely packed and fused below, septate, branched. *Conidiogenous cells* monophialidic with minute periclinal thickenings, lageniform to narrow conical, colourless, smooth-walled, 11-17 X 2-2.5 [$\bar{x}$ = 14.5 X 2.2] μm . *Conidia* ellipsoidal with a rounded or occasionally blunt apex and a narrow truncate base, unicellular, pale olivaceous, smooth-walled, 5-8(-10) X 2-3 [$\bar{x}$ = 6.4 X 2.5] μm , without a mucoid

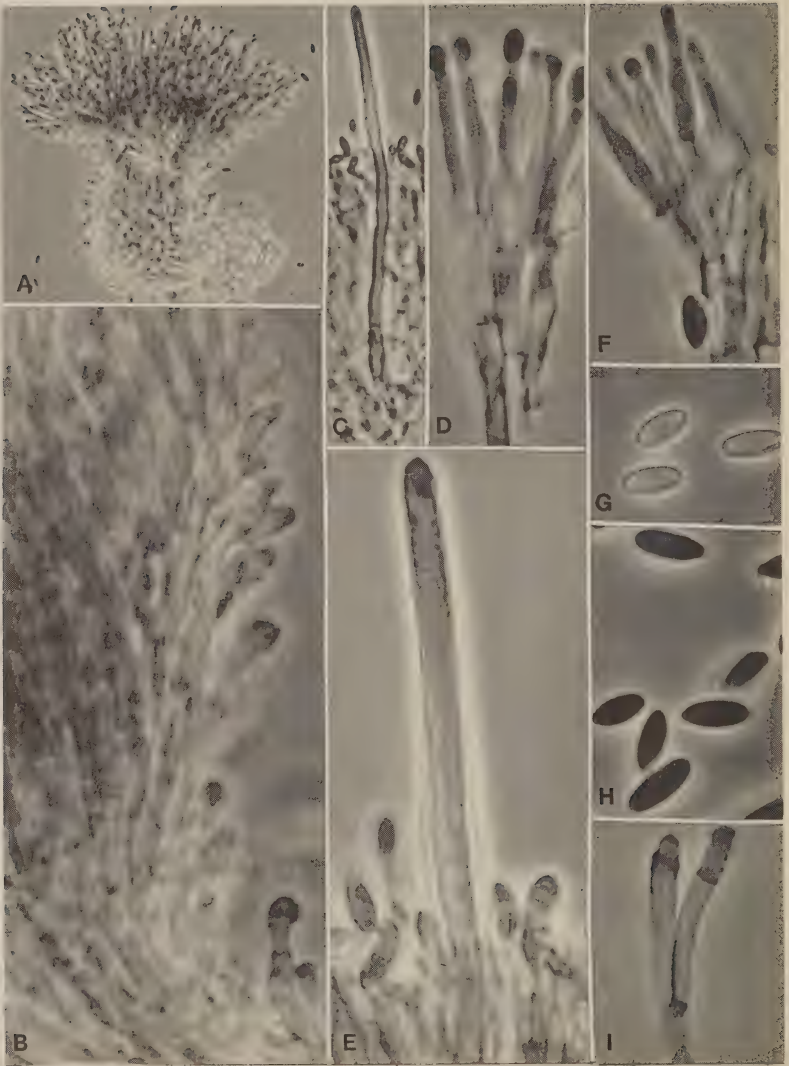


Figure 2. *Stilbella* sp. ex IMI 88728. A. Conidioma. B. Marginal elements. C & E. Setae. D & F. Conidiophores and conidiogenous cells. G & H. Conidia (G - water mount; H -lactic acid mount). I. Marginal elements. (A - ca X240; C - ca X475; D-I - ca X 1500).

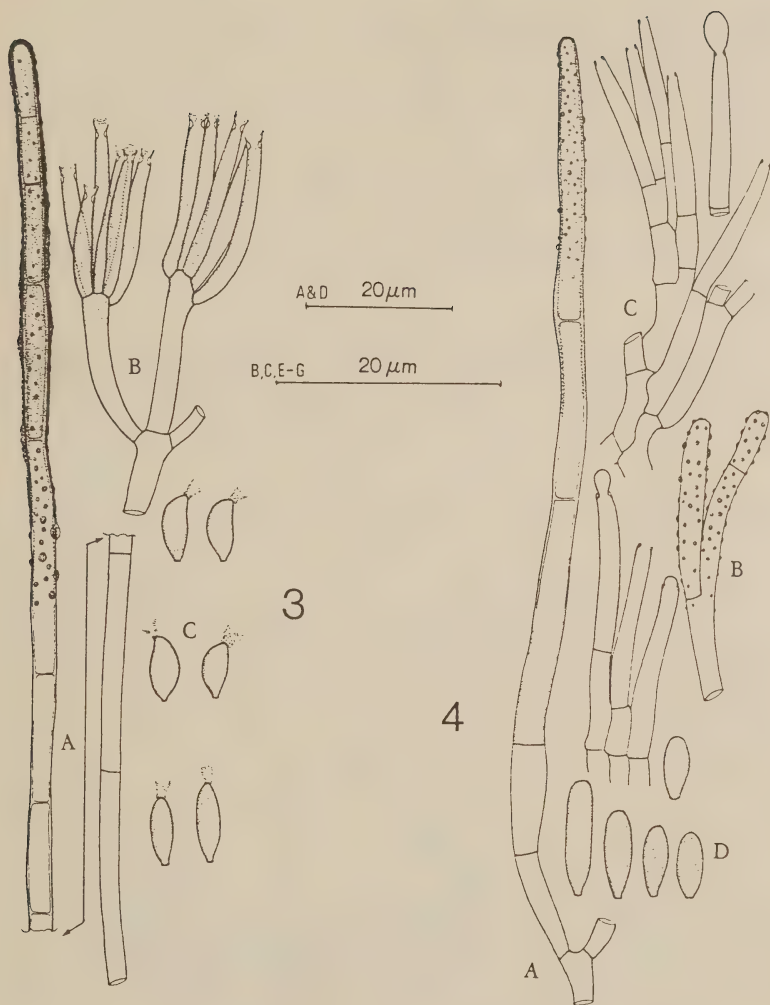


Figure 3. *Myrothecium prestonii* ex IMI 160372. A. Conidiomatal seta. B. Conidiophores and conidiogenous cells. C. Mature conidia. Figure 4. *Stilbella* sp. ex IMI 88728. A. Seta. B. Marginal elements from the stipe. C. Conidiophores and conidiogenous cells. D. Mature conidia.

appendage; mean conidium length/width ratio = 2.5:1.

Habitat: on *Erythrina* sp.

Specimen examined: IMI 88728, New Hebrides (no other data).

Known distribution: New Hebrides.

The fungus is associated with irregular, straw coloured leaf spots.

I refrain from applying a specific epithet to this collection, since it needs to be studied in greater detail to establish its affinity on a firm basis.

***Hymenopsis olivacea* Nag Raj anam.-sp. nov.**

Fig. 5

Caulicola. *Conidiomata* stromatica, dissita, originem subcuticularia, ut videtur pulvinata sed cupulata, ambitu ovalia vel irregularia, 150-210 μm lat., 80-120 μm alt., marginaliter setosa, nigrovirentia; stroma basali bene evoluto e textura angularis ex cellulis fuligineis composita; excipulum constatum e textura porrecta compacta et olivacea; hyphae marginales incurvae, cum cellulis terminales tumidae; setae conidiomatali subulatae, nonramosae, crassitunicatae, septiibus pluribus tenuioribus, hyalinae vel pallide olivaceae, laeves, 130-160 μm long., basi 6-12 μm lat., apice 1.5-2.5 μm lat. *Conidiophora* compacta, septata et ramosa, in muco involuta. *Cellulae conidiogenae* phialidicae, subcylindratae cum spissarum periclinali minuto et collarulo praeditae, laeves, infra hyalino, prope collarulo pallide olivaceo, 6-12 X 1.5-2.5 [$\bar{x}$ = 9.5 X 2.1] μm . *Conidia* fusiformia vel ellipsoidea apice acuto vel obtuso, base anguste truncato, unicellularia, olivacea, in massa atrovirentia, 3.5-7 X 2.5-3(-3.5) [$\bar{x}$ = 5.2 X 2.7] μm , haud una appendix apicalis; ratione conidii long./lat. = 1.9:1.

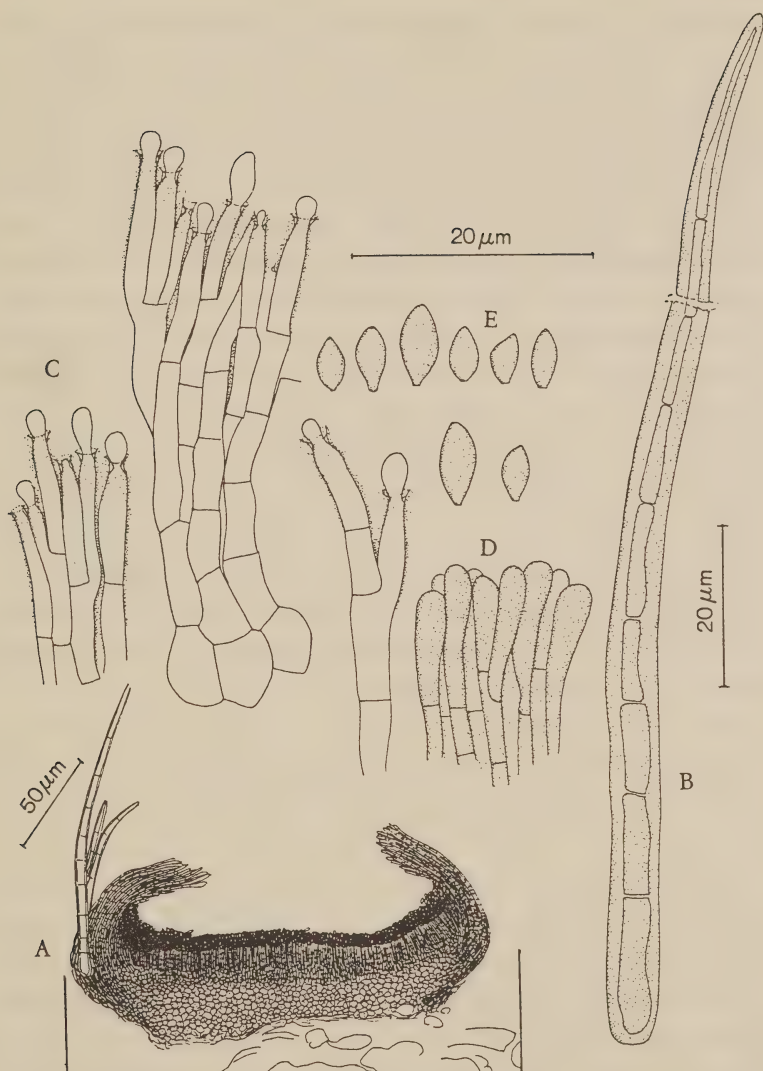


Figure 5. *Hymenopsis olivacea* ex K 6433. A. Vertical section of a conidioma. B. Conidiomatal seta. C. Conidiophores and conidiogenous cells. D. Partial enlarged view of terminal cells of excipular elements. E. Mature conidia.

Caulicolous. *Conidiomata* stromatic, scattered, subcuticular in origin, seemingly pulvinate but cupulate, oval or irregular in outline, 150-210 μm wide, 80-120 μm deep, marginally setose, greenish black; basal stroma well developed, of textura angularis, cells fuliginous; excipulum composed of compact olivaceous textura porrecta; marginal hyphae incurved, with swollen apical cells; conidiomatal setae subulate, unbranched, thick-walled, with many thin septa, colourless to pale olivaceous, smooth-walled, 130-160 μm long, 6-12 μm wide at the base, 1.5-2.5 μm wide at the apex. *Conidiophores* compact, septate and branched, invested in mucus. *Conidiogenous cells* phialidic, subcylindrical with minute periclinal thickenings and flaring collarettes, smooth-walled and colourless below but pale olivaceous near the collarette, 6-12 X 1.5-2.5 [$\bar{x}$ = 9.5 X 2.1] μm . *Conidia* fusiform to ellipsoidal with an acute to blunt apex and a narrow, truncate base, unicellular, olivaceous, dark green in mass, 3.5-7 X 2.5-3 (-3.5) [$\bar{x}$ = 5.2 X 2.7] μm , without an apical mucoid appendage; mean conidium length/ width ratio = 1.9:1.

Habitat: on *Thea* sp.

Specimen examined: K 6433 [Type], Moolaya, V.1922.

Known distribution: ? Sri Lanka.

H. saccardoana (Spegazzini) Sutton and *H. trochiloides* (Saccardo) Saccardo are the two species of *Hymenopsis* that are known to possess cupulate conidiomata and conidia without appendages (Sutton 1980). *H. saccardoana* lacks conidiomatal setae and its fusiform to clavate conidia are fuliginous and larger than those of *H. olivacea*. Conidiomatal setae rarely occur in *H. trochiloides*; but, when present, are brown unlike those of *H. olivacea*. Its conidia are greenish brown and longer than those of *H. olivacea*.

Foliicola. *Conidiomata* stromatica, epiphylla, raro amphigena, dissita vel gregaria, ut videtur superficialia sed originem subcuticularia, ambitu orbicularia vel ovalia, 90-200 μm long., 100-135 μm lat., 30-50 μm alt., nigra vel atra, excipulata, setosa; stroma basali moderate evoluto, e hyalina vel olivacea textura angularis in stratis infra ex cellulis crassitunicatibus composito insuper textura prismatica commiscenti; excipulo redacta, usque ad 50 μm alt. et 20 μm cr., externe ex textura porrecta e parum crassitunicatibus, atrantibus cellulis interne progressive pallidior composito, cellulis terminalibus excipularum clavato, simplices vel subinde lobatae et usque ad 3 μm lat.; setae conidiomatali subulatae, rectae vel varie curvae, nonramosae, crassitunicatae, 3-5-septatae, initio subhyalinae vel olivaceae, in pars medianus ultime atrantes, extremitibus pallidior, vulgo laeves, interdum apice minute verruculoso, 130-190 μm long, 8-9 μm ad pars latiora, apicem usque ad 2.5 μm lat. *Conidiophora* cavitatem conidiomatis enascentia, nonramosa vel ramosa ramuli infra septiis oriundi, confertim aggregata, hyalina vel pallide olivacea, laevia, in muco involuta. *Cellulae conidiogenae* phialidicae, subcylindraceae, fuligineis, infra pallidiorae prope collarulo crassitunicatibus, atrantes et verruculosae, usque ad quinquies percurrenter proliferantes, 7-12.5 X 1.5-3 [$\bar{x}$ = 9.5 X 2] μm . *Conidia* fusiformia vel subcylindracea, apice acuto vel obtuso, base anguste truncato, unicellularia, pallide olivacea, laevia, 8-16 X 1.5-2.5 [$\bar{x}$ = 13 X 2] μm , apice appendice ferentia; appendix infundibuliformis vel irregularis, mucosas; ratione conidii long./lat. = 6.5:1.

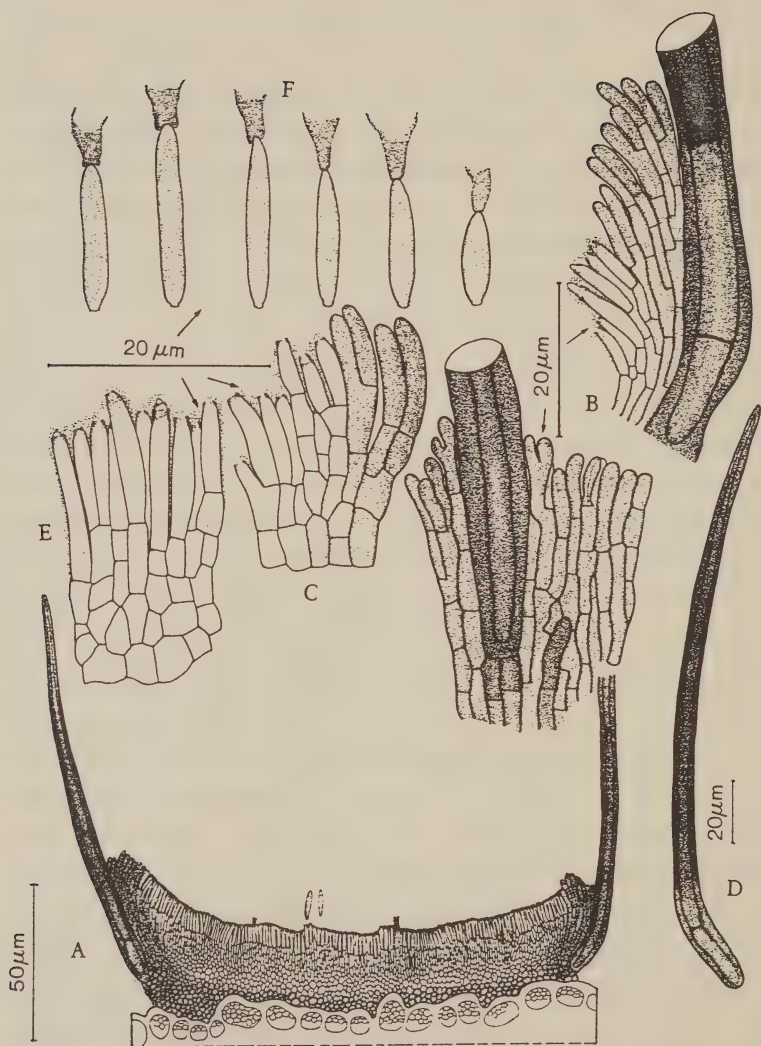


Figure 6. *Hymenopsis bambusae* ex type in DAOM 216717. A. Vertical section of a conidioma. B. & C. Partial enlarged view of excipular elements and a conidiomatal seta. D. Conidiomatal seta. E. Conidiophores and conidiogenous cells. F. Mature conidia.

Foliicolous. *Conidiomata* stromatic epiphyllous, rarely amphigenous, scattered to gregarious, seemingly superficial but subcuticular in origin, orbicular to oval in outline, 90-200 μm long, 100-135 μm wide, 30-50 μm deep, glistening to dull black, excipulate, setose; basal stroma moderately developed, of colourless to olivaceous *textura angularis* of thick-walled cells in the lower layers, merging with *textura prismatica* above; excipulum reduced, up to 50 μm high and up to 20 μm thick, of *textura porrecta* of slightly thick-walled, dark fuliginous cells in the exterior and progressively paler in the interior, terminal cells of the excipulum slightly clavate, simple or occasionally lobed and up to 3 μm wide; conidiomatal setae subulate, erect or variously curved, unbranched, thick-walled, 3-5-septate, initially almost colourless to olivaceous, ultimately dark in the median part, paler at the extremities, mostly smooth-walled, occasionally minutely roughened in the apical part, 130-190 μm long, 8-9 μm at the widest part, up to 2.5 μm wide at the apex. *Conidiophores* lining the cavity of the conidioma, simple or branched with the branches arising from below the septa, densely packed, colourless to pale olivaceous, smooth, invested in mucus. *Conidiogenous cells* phialidic, subcylindrical, fuliginous, pale below but becoming thick-walled, darker and roughened near the collarette, proliferating percurrently up to 5 times, 7-12.5 X 1.5-3 [$\bar{x}$ = 9.5 X 2] μm . *Conidia* fusiform to subcylindrical with a pointed or blunt apex and a narrow, truncate base, unicellular, pale olivaceous, smooth, 8-16 X 1.5-2.5 [$\bar{x}$ = 13 X 2] μm , with an everted, funnel-shaped or irregular, apical, mucoid appendage; mean conidium length/width ratio = 6.5:1.

Habitat: on fallen, decaying leaves of *Bambusa* sp.

Specimen examined: DAOM 216717 [Type], Nandi Hills, Karnataka State, India, 12.VIII.1970, T.R.Nag Raj.

Known distribution: India.

H. bambusae is comparable to *H. atroviride* (Berkeley & Broome) Nag Raj (Nag Raj 1993). The conidiomata of the latter species lack setae; its phialides are longer, smooth, colourless to uniformly olivaceous and the mean conidium length/width ratio is less than that of *H. bambusae*.

Acknowledgments

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MYCOTAXON

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LOMACHASHAKA REVISITED

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With the reinstatement of *Lomachashaka*, the monotypic anamorph-genus is augmented to include additional three species.

During the last twenty five years, I have seen a number of intriguing collections of conidial fungi that superficially resembled *Myrothecium* Tode : Fries, yet appeared to be distinctive. In each case, the fungus (cf. Fig. 1A-H) was characterized by shallow cupulate, sporodochial conidiomata with setae occurring in a peripheral white fringe extending well above the conidiiferous layer and surrounding an agglutinated dark green or greenish black mass of conidia. The basal stroma was composed of thick-walled hyaline cells in a lower textura angularis merging with an upper textura prismatica that gave rise to the setae and conidiophores. The conidiomatal setae had a short, swollen, septate base, and a long, flexuous, slender, thick- and smooth-walled upper part with a narrow lumen. The conidiophores were branched, smooth, colourless and terminated in monophialides. The conidia were unicellular, pale olivaceous, smooth, bearing a mucoid, apical appendage. Either

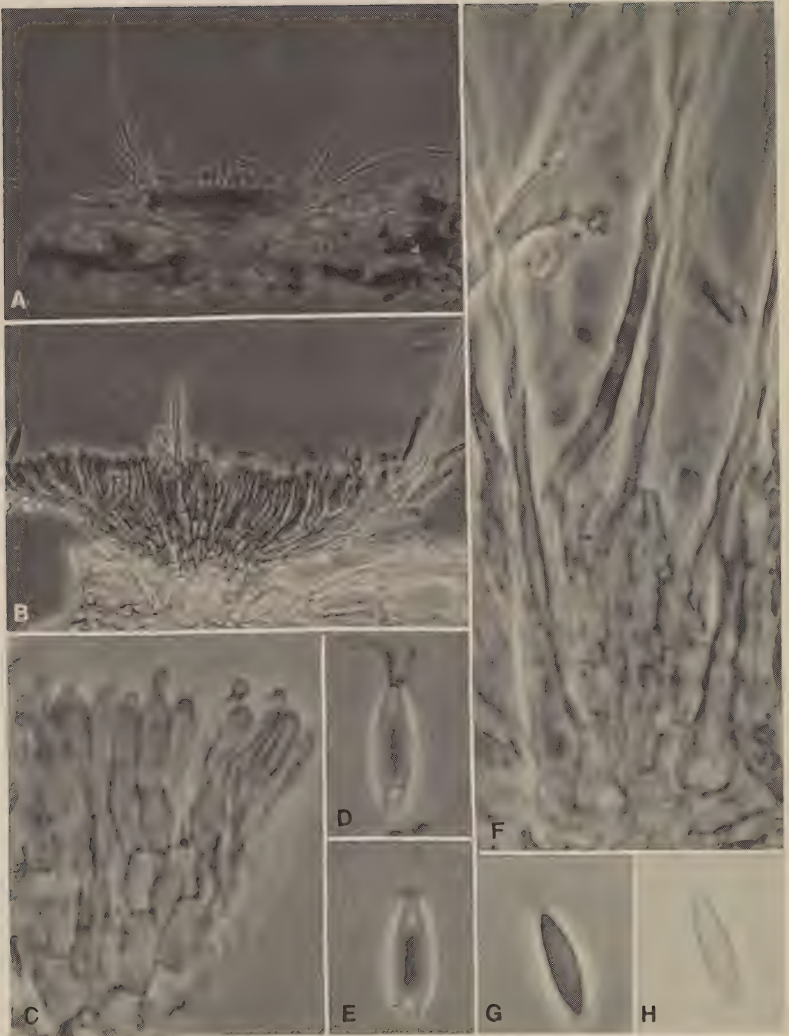


Figure 1. *Lomachashaka sundara*. A & B. Vertical section of conidiomata. C. Conidiophores and phialides. D, E, G, & H. Conidia in aqueous and lactic acid mounts under phase and bright field optics. F. Conidiomatal setae. (A. ca X195; B. ca X485; C-H. ca X1520).

Myrothecium, or *Lomachashaka* Subramanian (with its characters closely approximating those of the collections under study), appeared to be a logical choice as a generic niche for these collections.

Subramanian (1956) proposed the monotypic genus *Lomachashaka* for a fungus observed on dead leaves of *Cocos nucifera* from Madras, India. Superficial, cup-like sporodochia fringed with numerous, unbranched, colourless, septate, sterile hairs; colourless conidiophores terminating in phialides; and unicellular, colourless conidia with a single, apical, mucoid appendage were considered diagnostic for the genus. Tulloch (1972) published a revised *sensu lato* concept of *Myrothecium* using the colour of the conidial mass as the diagnostic character linking species with sporodochial, synnematosus and cupulate conidiomata. She included *Lomachashaka* in her list of "doubtful and excluded genera," and hinted at its possible affinity with *Myrothecium*. Carmichael *et al.* (1980) listed it as a synonym of *Myrothecium*. Nag Raj (1993, 1994), however, opted to limit *Myrothecium* to species with glabrous or setose, pulvinate sporodochial or synnematosus conidiomata, and excluded species with cupulate conidiomata.

In the light of the preceding preamble and the restricted concept of *Myrothecium* advocated by Nag Raj (1993, 1994), resuscitation of *Lomachashaka* for the collections reported in the present study has to be considered. Neither MUBL, the reported repository of the type specimen of *L. kera* Subramanian, nor any other international herbarium is known to carry the type specimen. There is no evidence to indicate that the fungus was collected again from the type or other localities in India. The original illustration (Fig. 3) and description which form part of the protologue of *L. kera*, though far from satisfactory, have to

serve as a guide for a reassessment of the generic concept of *Lomachashaka*. Subramanian's (1956) interesting way of characterising the conidiophores of the fungus as "arising from hyaline, septate hyphae in a closely arranged hymenium" is characteristic of descriptions of taxa published in the fifth and sixth decades of this century, when the significance of the tissue types in conidiomatal anatomy were overlooked or ignored. His characterisation of the conidiomata of *L. kera* as cup-like sporodochia (Fig. 3A) with a white fringe is also relevant and comparable to the type of conidiomata encountered in the collections under study. The thin-walled, septate sterile hyphae and the reported quantitative characters are the only differences perceptible between *L. kera* and these collections, which can be brought into *Lomachashaka* by broadening the generic concept. This approach is preferable to proposing a new generic name for the collections discussed here. Table 1 highlights the characteristic morphological features of *Lomachashaka* and *Myrothecium*.

LOMACHASHAKA Subramanian [char. emend. Nag Raj]
J. Ind. Bot. Soc. 35: 67, 1956.

Conidiomata sporodochial, superficial, shallow cupulate, green in the centre with a fringe of sterile hairs or setae extending well above the conidial hymenium; basal stroma of a basal hyaline, textura angularis merging with an upper, hyaline textura prismatica or a compact textura intricata and an outer sheath of cells that give rise to the sterile elements; sterile elements hypha-like, unbranched, thin-walled, colourless, septate and of uniform width, or setose with thick-wall and a narrow lumen, smooth or ornamented and septate in the basal part. *Conidiophores* simple or branched, septate. *Conidiogenous cells* phialidic, subcylindrical to lageniform with flaring collarettes

Table 1. Distinguishing morphological features of
Myrothecium and *Lomachashaka*.

Features	<i>Myrothecium</i>	<i>Lomachashaka</i>
Conidioma	synnema/sporodochium, pulvinate	sporodochium, shallow, cup-like
Sterile elements	+/-; when present, setose, random in distribution, in the conidioma, thick-walled, smooth or ornamented, colourless or pigmented	+; hypha-like, of uniform width; or setose, septate at smooth or ornamented base, apical part long, smooth, slender, with narrow lumen; colourless
Conidiomatal anatomy	lax or compact textura intricata	a basal textura angularis and an upper textura prismatica
Conidiophores	lax or compact	compact
Conidia	cylindrical, ellipsoid; symmetrical or asymmetrical; colourless or olivaceous; with or without an apical mucoid appendage	fusiform; olivaceous; appendage apical, mucoid

and moderate to marked periclinal thickenings, thin-walled and smooth. *Conidia* fusiform, unicellular, colourless to pale olivaceous, smooth, with an apical mucoid appendage arising by eversion of a partial mucoid sheath.

Type anamorph-species: *Lomachashaka kera* Subramanian.

Teleomorph: Unknown.

Key to species

- A. Sterile elements filiform, uniformly wide, thin-walled
 *Lomachashaka kera* (3)
- A. Sterile elements filiform, thick-walled with narrow lumen for
 a major part of their lengths and separated from the bulbous
 base by a septum B
- B. Conidiogenous cells colourless, vase-shaped with walls
 invaginated in the median part; basal cell of the conidiomatal
 setae smooth-walled *Lomachashaka cynodontis* (2)
- B. Conidiogenous cells pale olivaceous, ampulliform; basal cell
 of conidiomatal setae ornamented C
- C. Mean conidium length = 10.8 μm ; mean conidium width =
 2.9 μm *Lomachashaka sundara* (4)
- C. Mean conidium length = 7.7 μm ; mean conidium width = 2.2
 μm *Lomachashaka africana* (1)

1. *Lomachashaka africana* Nag Raj anam. sp.-nov.

Fig. 2A-C

Conidiomata plerumque epiphylla, dissita vel gregaria, ut videtur superficialia, applanata vel discoidea, ambitu orbicularia vel ovalia, 140-200 μm diam., 30-40 μm alt., a albida fimbria

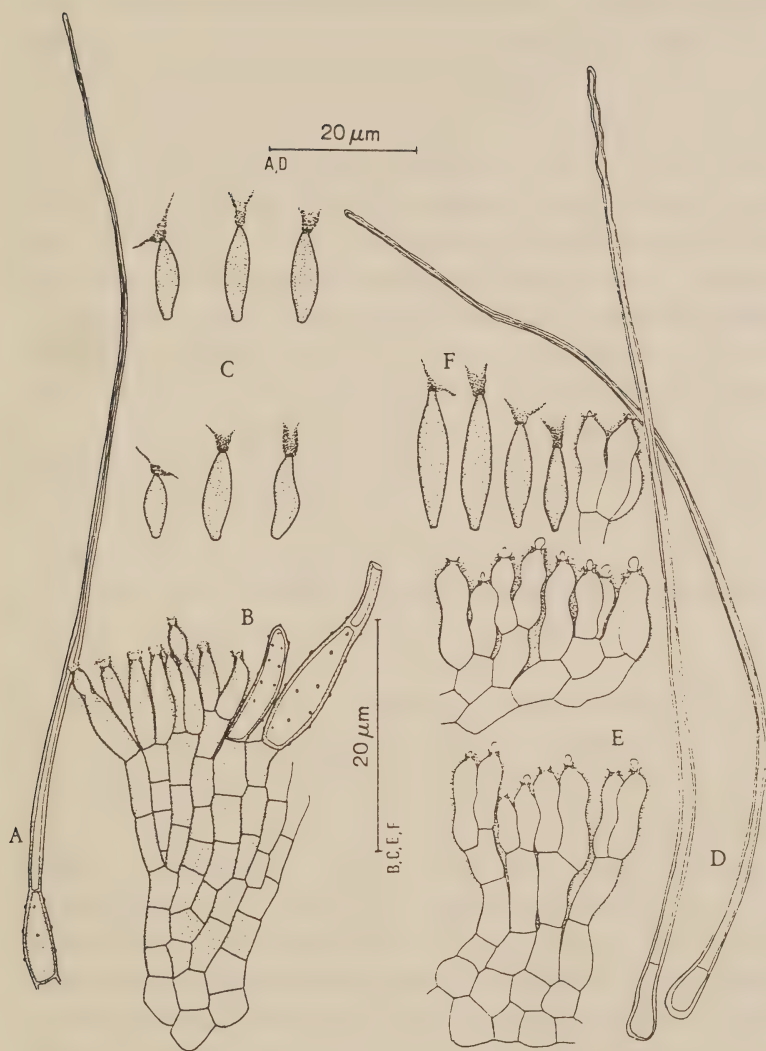


Figure 2. A-C. *Lomachashaka africana*. A. Seta. B. Conidiogenous cells and part of a seta. C. Mature conidia. D-F. *Lomachashaka cynodontis*. D. Conidiomatal setae. E. Conidiogenous cells. F. Conidia.

setarum marginalium divergentium circumdata; stromate basali bene evoluto, e cellulibus crassitunicatibus, hyalinibus vel pallide olivaceis in una basali textura angularis insuper textura prismatica commiscenti composito; setae filiformes, flexuosae, basi bulboso vel subcylindraco, irregulatim denticulato, 6-15 X 3-4 μm , parte apicali lumine angustati et 70-160 μm long., gracili, irregulatim nodulosi, crassitunicati et laevi a septiis sejunctae. *Conidiophora* compacta, ramosa, laevia, hyalina vel pallide olivacea. *Cellulae conidiogenae* subcylindracoae vel subinde lageniformiae, pallide olivaceae, laeviae, cum una collarulo tenui praeditae, 7-11 X 2-3 [$\bar{x}$ = 9.3 X 2.4] μm , semel vel bis percurrenter prolificantes. *Conidia* fusiformia vel elliptica, apice acuto, basi anguste truncato et parum mamillato, subinde curvata, unicellularia, pallide olivacea, laevia, 6-9.5 X 2-2.5 [$\bar{x}$ = 7.7 X 2.2] μm , unam appendicem ferentia; appendix apicalis, infundibuliformis, mucosa; ratione conidii long./lat. = 3.5:1.

Conidiomata mostly epiphyllous, scattered to gregarious, seemingly superficial, applanate to discoid, orbicular to oval in outline, 140-200 μm diam., 30-40 μm high (excluding the agglutinated, dark green or almost black conidial mass), surrounded by a thick, white fringe of divergent, marginal, sterile setae; basal stroma well-developed, composed of thick-walled, colourless to pale olivaceous cells in a basal textura angularis merging with an upper textura prismatica; setae arising from the outer upper cells of the basal stroma, filiform, flexuous, basal part somewhat bulbous or subcylindrical with irregularly denticulate walls, 6-15 X 3-4 μm , separated from a slender, irregularly nodulose, thick-walled, smooth, upper part 70-160 μm long with a narrow lumen. *Conidiophores* tightly packed, branched, smooth, colourless to pale olivaceous. *Conidiogenous cells* subcylindrical to occasionally lageniform with a flaring

collarette and moderate periclinal thickenings, pale olivaceous, smooth, 7-11 X 2-3 [$\bar{x}$ = 9.3 X 2.4] μm , proliferating percurrently once or twice. *Conidia* fusiform to ellipsoidal with an acute apex and a slightly mamillate but narrow and truncate base, occasionally curved, unicellular, pale olivaceous, smooth, 6-9.5 X 2-2.5 [$\bar{x}$ = 7.7 X 2.2] μm , with a funnel-shaped, mucoid apical appendage; mean conidium length/width ratio = 3.5:1.

Habitat: On leaves of *Pennisetum purpureum*.

Specimen examined: IMI 41287 [Holotype], Togoland, 28.V.1949, S.J.Hughes.

Known distribution: Togoland (Africa).

2. *Lomachashaka cynodontis* Nag Raj *anam.-sp. nov.*

Fig. 2D-F

Conidiomata 160-220 μm diam., 40-80 μm alt.; setae filiformes, flexuosae, nonramosae, 50-140 μm long., basi ampulliformi vel conica, pariete laevi, 7-12 X 3.5-4.5 μm , parte insuper gracili, irregulatim nodulosi, crassitunicati, laevi, lumine perangustati, a tenui septo sejunctae. *Cellulae conidiogenae* urceolatae, hyalinae, laeves, 7.5-9(-10) X 2.5-3.5 [$\bar{x}$ = 8.6 X 3] μm , semel vel bis percurrenter proliferantes. *Conidia* pallide olivacea, 6-11.5(-12.5) X 2-3 [$\bar{x}$ = 8.7 X 2.5] μm , apice unam mucosam, appendicem ferentia; ratione conidii long./lat. = 3.4:1.

Conidiomata mostly epiphyllous, scattered to gregarious, seemingly superficial, applanate to discoid, orbicular to oval in outline, 160-220 μm diam., 40-80 μm high excluding the agglutinated, dark green or almost black conidial mass surrounded by a thick, white fringe of divergent marginal hairs; basal stroma well-developed, composed of thick-walled, colourless to pale olivaceous cells in a basal textura angularis merging with an upper textura prismatica; setae unbranched,

ERRATUM

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Page 320, line 16

[holotype of *Lomachashaka cynodontis*] for IMI 39603b read IMI 39630b

50-140 μm long, base ampulliform to conical with smooth walls, 7-12 X 3.5-4.5 μm , separated from a flexuous, slender, irregularly nodulose, thick-walled, smooth, upper part with a narrow lumen by an indistinct septum. *Conidiophores* well compacted, branched, smooth, colourless to pale olivaceous. *Conidiogenous cells* vase-shaped with the walls invaginated in the median part, colourless, smooth, with a flaring collarete and moderate periclinal thickenings, 7.5-9(-10) X 2.5-3.5 [$\bar{x}$ = 8.6 X 3] μm , proliferating percurrently once or twice. *Conidia* fusiform to elliptic with an acute apex and a slightly mamillate, but narrow and truncate base, occasionally curved, unicellular, pale olivaceous, smooth, 6-11.5(-12.5) X 2-3 [$\bar{x}$ = 8.7 X 2.5] μm , with a funnel-shaped, mucoid apical appendage; mean conidium length/width ratio = 3.4:1.

Habitat: On leaves of *Cynodon dactylon*.

Specimen examined: IMI 39603b [Holotype], Ghana, 4.VI.1949, S.J.Hughes (1105).

Known distribution: Ghana (Africa).

3. *Lomachashaka kera* Subramanian

Fig. 3

J. Ind. Bot. Soc. 35: 67, 1956.

Conidiomata scattered, superficial, cup-like with a green centre and a white fringe, circular or oval in outline, 210-350 μm diam., 80-100 μm high; white fringe extending well above the conidiiferous layer and composed of unbranched, thin-walled, colourless, erect or flexuous sterile elements, up to 200 μm long and 1.5-2.5 μm wide. *Conidiophores* closely aggregated, branched, smooth and colourless. *Conidiogenous cells* subcylindrical to lageniform, colourless, 13-19 μm long, up to 3 μm wide. *Conidia* fusiform with a slightly mamillate base, unicellular, colourless, 9-14 X 2-4 [$\bar{x}$ = 11.5 X 3.3] μm , with a funnel-shaped, mucoid, apical appendage; mean conidium length/

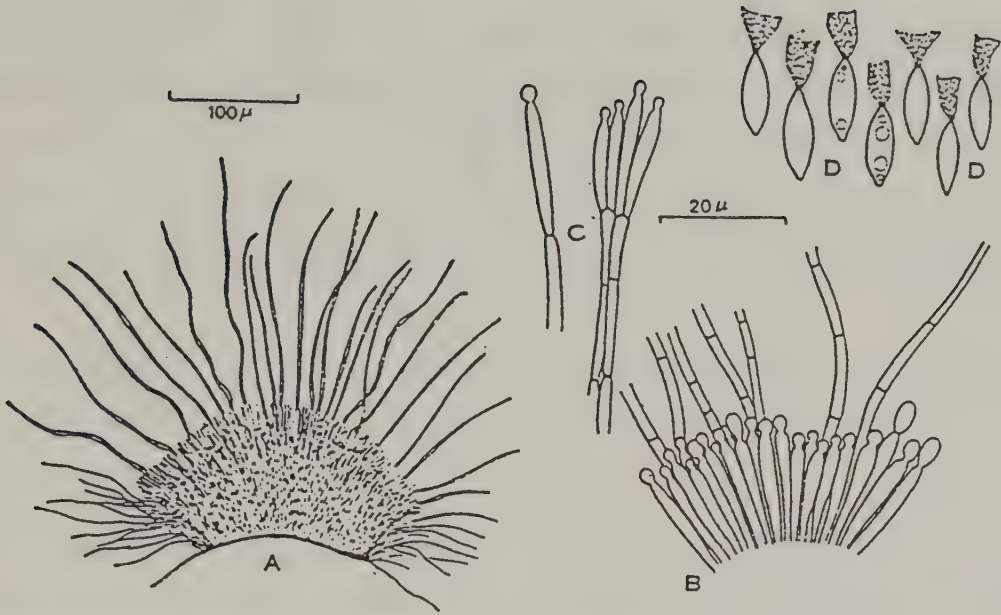


Figure 3. *Lomachashaka kera* (after Subramanian 1956). A. Conidioma. B. & C. Conidiophores, conidiogenous cells and sterile elements. D. Conidia.

width ratio = 3.5:1.

Habitat: On dead leaves of *Cocos nucifera*.

Type specimen: MUBL 955 [does not exist in the herbarium now; Fig. 8 in Subramanian, J. Ind. Bot. Soc. 35: 66, 1956 is to be considered as the lectotype].

Known distribution: Type locality.

The above description is derived from the original account of the fungus published by Subramanian (1956).

4. *Lomachashaka sundara* anam.-sp. nov. Figs. 1A-H, 4

Conidiomata 100-180 μm diam., 60-100 μm alt.; setae basi verruculoso et sufflato, 15-20 μm alt. et 2.5-3.5 μm lat., insuper in parte gracili, crassitunicati, irregulatim nodulosi, laevi, cum lumine perangustati terminans, nonramosae, flexuosae, ad basim

1-2-septatae, 120-300 μm longae. *Cellulae conidiogenae* subcylindraceae vel lageniformiae, in parte insuper pallide olivaceis vel fuligineis, (5-)9-15 X 2.5-3 [$\bar{x}$ = 11.5 X 2.7] μm . *Conidia* 7-12.5(-17) X 2.5-3.5 [$\bar{x}$ = 10.8 X 2.9] μm , apice unam mucosam appendicem ferentia; ratione conidii long./lat. = 3.7:1.

Conidiomata amphigenous, scattered, rarely gregarious, seemingly superficial, but intra-epidermal in origin, pulvinate to discoid or cupulate, orbicular to oval in outline, 100-180 μm diam., 60-100 μm high, setose with the setae associated with a peripheral white fringe extending well above the conidiiferous layer and surrounding a agglutinated dark green or greeinsh black conidial mass; basal stroma well developed, composed of thick-walled, colourless cells in a basal textura angularis merging with an upper textura prismatica and an outer sheath of cells that give rise to the fringe of setae; conidiomatal setae unbranched, flexuous, 1-2-septate at base, consisting of a verruculose, swollen base 15-20 X 2.5-3.5 μm , and a slender, thick-walled, irregularly nodulose, smooth, 120-300 μm long upper part with a narrow lumen. *Conidiophores* branched, smooth, colourless. *Conidiogenous cells* subcylindrical to lageniform with a flaring collarete and marked periclinal thickenings, pale olivaceous to fuliginous, smooth, (5-)9-15 X 2.5-3 [$\bar{x}$ = 11.5 X 2.7] μm . *Conidia* fusiform or fusiform-elliptic with an acute apex and a slightly mamillate and narrow truncate base, unicellular, pale olivaceous, smooth, 7-12.5(-17) X 2.5-3.5 [$\bar{x}$ = 10.8 X 2.9] μm , with a funnel-shaped, mucoid, apical appendage; mean conidium length/width ratio = 3.7:1.

Habitat: On grass blades.

Specimen examined: DAOM 216716 [Holotype], Hebbal, Bangalore, India, 2.VII.1970, T.R.Nag Raj.

Known distribution: India.

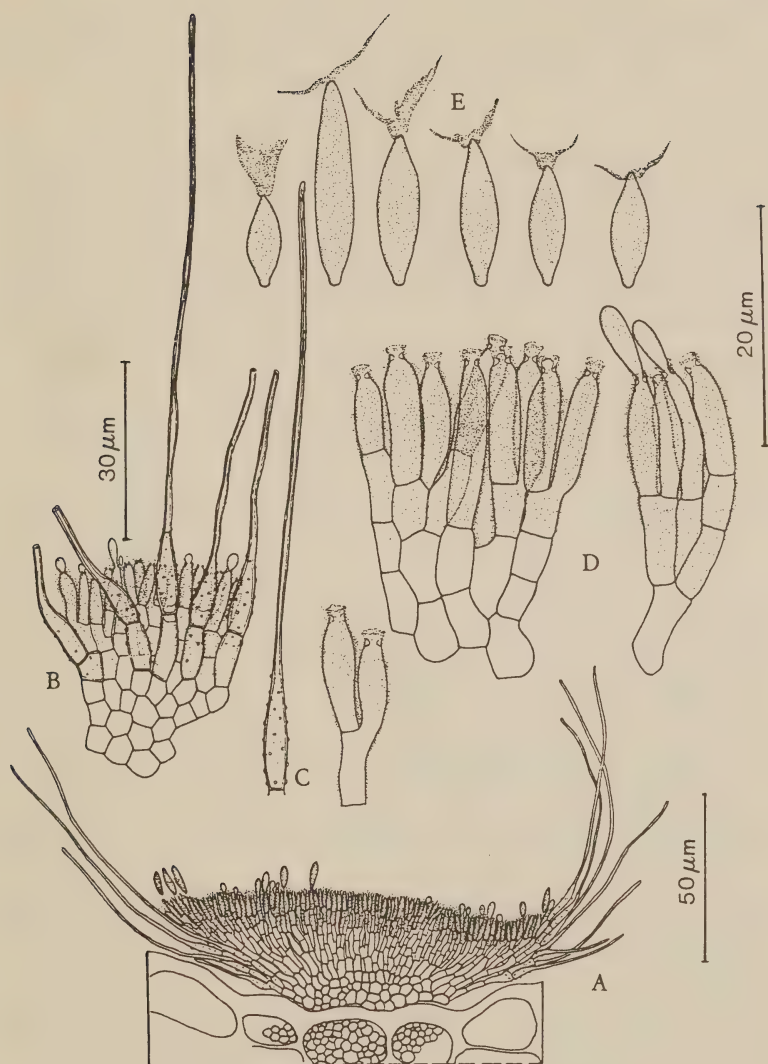


Figure 4. *Lomachashaka sundara* ex type in DAOM 216716. A. Vertical section of a conidioma. B. Tissue details, conidiogenous cells and setae. C. Seta. D. Conidiogenous cells. E. Conidia.

Acknowledgments

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Observations on *Leucoagaricus melanotrichus* and similar species

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SUMMARY

Descriptions are given of *Leucoagaricus melanotrichus* and *L. melanotrichus* var. *fuligineobrunneus*, a new taxon *L. melanotrichus* var. *septentrionalis* var. nov. is described, based on collections from two nearby localities in Eastern England, *Leucocoprinus caeruleoviolaceus* is reduced to varietal status of *Leucoagaricus ionidicolor*. An account of *L. tener* is also given. A key is provided to these and similar taxa.

These agarics belong to a group of closely related species or species of similar appearance, which vary from very small to medium sized, with the pileus to 50(60) mm diam. Several species have the pileus coloured purple, violaceous, lilac or rose (*L. ianthinophaeus*, *L. ionidicolor*, *L. i. caeruleoviolaceus*, *L. marriagei*), others grey or brownish grey sometimes with a violet tint (*L. melanotrichus*, *L. m. fuligineobrunneus*, *L. m. septentrionalis*) or brown (*L. tener*). In most species the pileus is covered especially at the disc, which is usually darker or even blackish, with a loose tangle of woolly fibrils, which collapse on to the cap surface as darker radially orientated arachnoid fibrils or fleck-like scales on a pale whitish background; these fibrils or flecks become increasingly dispersed toward the margin. The stipe is annulate (except in *L. ianthinophaeus*), and bears an erect membranous, often dark edged ring. Cheilocystidia abundant, commonly clavate or cylindric. Spores frequently amygdaliform to short amygdaliform but varying to elongate-elliptic, elliptic or subcylindric, with thickened dextrinoid wall, but lacking a germ pore. Fibrils on cap surface comprising chains of prostrate segments in which the terminal element may be poorly differentiated, shortish and blunt (*L. melanotrichus*, *L. m. fuligineobrunneus*, *L. m. septentrionalis*, *L. tener*), or elongated and appearing hair-like or cystidiiform with a narrowed pointed apex (*L. marriagei*, *L. ionidicolor*). In *L. ianthinophaeus* the cap surface is formed of scattered upturned hyphal endings forming small tufts of cylindric elements, intermixed with spherical or short inflated vermiform organs. Clamp-connexions lacking in all taxa. These species may be keyed out as follows:

- 1a Pileus predominantly purple violaceous, lilac or rosy, often darker at the disc [if grey with hint of these colours see 1b] 2
- 2a Stipe exannulate, but with appendiculate velar remnants on cap margin.

- Fruitbody relatively robust, stocky; Pileus 30-60 mm diam., stipe 50-60 mm high, 4-7 mm wide. Cap surface disrupting into minute cottony flocci toward the margin, then splitting or not into broad scales; the microscopic structure comprising a layer of loose prostrate hyphae with very thick refringent walls and brown membranal pigment, some of these hyphae becoming upturned to form tufts of cylindric elements $37-48 \times 3.5-8.0 \mu\text{m}$, which may sometimes appear almost palisadic; intermixed with these elements are scattered spherical cells to $15 \mu\text{m}$ diam., and short inflated vermiform elements to $38 \times 8 \mu\text{m}$, which stain in cresyl blue. Spores $4.7-6.0 \times 3.4-4.0 \mu\text{m}$, originally described as citriform or rounded in face view and shortly amygdaliform in profile [but illustrated by the original author as oval and obtusely elliptic respectively]..... *L. ianthinophaeus*
- 2b. Stipe annulate; cuticular structure of pileus otherwise 3
- 3a. Spores $6.5-8.0 \times 3.2-4.0 \mu\text{m}$, amygdaliform. Fruitbodies less robust, more 'elancée' and delicate. Annulus with dark rim. Cap surface of loose fluffy or cottony fibrils, disrupting radially into arachnoid strands or chains of segments, with the terminal element elongate fusoid, to $164 \mu\text{m}$ long and $16 \mu\text{m}$ wide; subterminal elements often of similar width to the ultimate segment
..... *L. marriagei*
- 3b. Spores $5.0-6.75 \times 3.0-4.0 \mu\text{m}$, narrowly elongate-elliptic, subcylindric or narrowly amygdaliform. Cheilocystidia clavate $30-50 \times 6-11.5 \mu\text{m}$. Surface of pileus of articulated elements with the terminal one cystidiiform, varying fusiform or clavate, to $200(300) \mu\text{m}$ long, $11-16 \mu\text{m}$ wide. Stature as for preceeding species or more robust
..... 4
- 4a. Pileus 30-50 mm diam. Cap colour recalling that of *Calocybe ionides*. Pileal surface disrupting into adpressed, granular, lilac scales on a pale lilac-white ground, except at the darker entire umber-lilac disc. Stipe 50-70 mm long, 3-6 mm wide, with bulbous base to 10 mm wide, white, below the annulus with brown-lilac fibrils. Annulus infundibuliform, lilac with rim of upper surface lilac-fuscos. Spores $(5.0) 5.5-6.5 \times (3.0) 3.3-3.7 (4.0) \mu\text{m}$, ellipsoid fide original authors [but illustrated from the holotype by Candusso & Lanzoni (1990) as narrowly elongate-elliptic, subcylindric or narrowly amygdaliform]. Cheilocystidia $30-45 \times 8-11 \mu\text{m}$. Pileal surface a trichoderm of articulated elements with the terminal one cystidiiform to $200(300) \mu\text{m}$ long, $11-16 \mu\text{m}$ wide
..... *L. ionidicolor* var. *ionidicolor*.
- 4b. Pileus 45-60 mm diam. Cap colour a beautiful blue-violet with darker disc. Pileal surface disrupting except at the entire disc into minute "Dark Purple Vinaceous" felty-fibrillose scales on a white to pale lilac ground. Stipe 70-80 mm long, 7-8 mm wide at the sub-bulbous base, violet above the annulus, but more reddish violet below. Annulus infundibuliform, white, lacking a dark rim. Spore sprint white. Spores $5.0-6.75 \times 3.0-4.0 \mu\text{m}$, narrowly blunt-elliptic to subamygdaliform. Cheilocystidia $35-50 \times 6.5-11.5 \mu\text{m}$. Pileal surface with pale brown cylindric, clavate or lanceolate cystidiiform elements to $100 \mu\text{m}$ long and $13-16 \mu\text{m}$ wide, occasionally with a conspicuous apical prolongation. Surface of stipe

with elongated pale brown fusiform hairs to 360 μm long, 15 μm wide, tapering markedly to both base and apex

.....*L. ionidicolor* var. *caeruleoviolaceus* (Reid) Reid, comb. nov.
[Basionym *Leucocoprinus caeruleoviolaceus* Reid in Mycol. Res. 93, 413, 1989].

- 1b Pileus grey to brownish-grey or brown; surface of darker arachnoid fibrils or radial fleck-like scales, comprising simple or branched chains of segments, with the terminal element bluntly rounded and not appreciably wider than the subterminal segments 5
- 5a Pileus grey or brownish grey with dark, often blackish disc 6
- 6a Pileus medium sized, (10) 20-30(50) mm diam., grey sometimes with hint of purple or violet. Spores 6.5-7.5 (-8.0) x 4.0-4.5 μm *L. melanotrichus*
var. *melanotrichus*
- 6b Pileus small, 10-15 (20) mm diam., grey brown, dark at disc, becoming paler to the margin. Spores (6.5-) 7.0-8.0 (-8.5) x 3.5 - 4.0 (-4.5) μm , elliptic *L. melanotrichus* var. *fuligineobrunneus*.
- 6c Pileus small, 6-12(15) mm diam, similar to previous but spores smaller, 5.0-6.5(-7.0) x 3.0-4.0 μm , amygdaliform *L. melanotrichus* var. *septentrionalis*
- 5b Pileus 18-25 mm diam. vandyke brown to deep ochraceous buff at disc, elsewhere with small ochraceous or ochraceous tawny, fibrillose flecks on a whitish or pale ochraceous background. Spores 6.0-8.0 x 3.2-4.0 (-4.2) μm , short amygdaliform to narrowly elliptic to subcylindric *L. tener*
- 1c Pileus with reddish-brown or rusty-date adpressed or slightly upturned scales, sometimes darker, chocolate or vandyke brown at the entire, velvety-tomentose disc; the latter comprising erect, unicellular fusoid hairs, 80-250 μm long, 7-20 μm wide, tapering to an elongated narrow base, and with a distinct wall 7
7. Fruitbody stocky; pileus 14-24 mm diam; stipe 15-27 x 1.5-3 mm, enlarging to 4-6 mm wide at the base, white with a well developed, membranous ring, sometimes edged below at the rim with a few red-brown scales. Cheilocystidia clavate to fusoid. Spores 5.0-7.5 x 3.5-4.0 μm , ellipsoid to slightly amygdaliform. Clamps lacking.
..... *L. brunneocingulatus*

[N.B. Huijsman (1955) described a *Leucoagaricus purpureo-lilacinus*. This is another purplish-brown species, with an almost polished (subnitid) surface to the cap, although often becoming inconspicuously cracked and adpressed squamulose toward the margin, which fades to a pale purplish flesh colour. The stipe, 10-75 x 6-10(14) mm, is both thickened and somewhat rooting below, white becoming pale lilac flesh colour toward the base. There is a well-developed, white, submembranous ring, although often deciduous, which lacks a dark rim. Spore print pale lilac-pink. Spores 8.3-10.0(-12.2) x 4.1-5.1 μm , narrowly amygdaliform, dextrinoid, without a metachromatic poral tractus. Cheilocystidia 24-48 x 8-10 μm , cylindric to subclaviform often with small

scattered crystalline particles. Clamps lacking. This species differs from those keyed out above in the structure to the pileal surface, which comprises radial, repent hyphae, 5-8 μm wide, with brownish membranal pigment.]

Leucoagaricus melanotrichus (Malenc. & Bert.) Trimb., Docum. Mycol. **5**, 42, 1975.
Lepiota melanotricha Malenc. & Bert., Fl. Champ, super. Maroc. **1**, 134, 1970.

The following description is adapted from the original account of the species as published by Malencon & Bertault (1975).

Pileus 15-20 mm becoming flattened, with a low obtuse umbo, to more or less depressed at the centre. Surface adpressedly fibrillose-woolly, ashy-grey to black with a violaceous tint, or sometimes slightly bronze-green at first, soon disrupting into 'flocons' or fine flecks which become increasingly dispersed toward the periphery, which appears pale speckled, and non-striate. *Stipe* separable, 18-30 x 2.0-3.5 mm, elancée, equal or slightly bulbous below, white, delicately pruinose under the lamellae, fibrillose below and ornamented with grey or blackish flecks. *Annulus* erect membranous, fragile, sometimes remaining attached to the base of the stem or splitting and appendiculate from the cap-margin, white bordered and shortly fringed with black. *Lamellae* free, milk white or cream. *Cheilocystidia* 25-45 (52) x 7 - 11 - 13 μm clavate, and amongst them some narrower, irregular tortuous elements, 5 μm wide. *Spores* 6.0 - 7.5 x 3.8 - 5.0 μm , exceptionally 7.8 - 9.0 x 4.6 - 5.4 μm , smooth, elliptic, with slightly thickened wall, the epispore red-brown in Melzers solution, the endospore red in cresyl-blue, lacking an obvious germ pore, but with a fairly distinct apical 'cal'. *Pileal surface* of prostrate elements, 5-7 μm wide, from which arise hairs which are loose and entwined at the disc, but adpressed elsewhere, articulated; lacking clamp connexions at the septa, of short cylindric or barrel-shaped elements, to 12 μm diam. These hairs are simple or shortly branched and aggregated into fibrils; sometimes hyaline with finely granular contents impregnated with a brown or bistre pigment sometimes dissolved in a large central vacuole, and in old or dead elements coarsely aggregated into rounded masses.

Tufts of similar hairs form the dark rim of the annulus, and are also found more sparsely in the blackish fibrils at the base of the stem.

Habitat: Fairly frequent, but always scattered; terrestrial, in the maquis with *Cistus* spp. *Erica*, 'Myrtes' and *Arbutus*, or in open forest with broadleaved trees and conifers; *Quercus ilex*, *Q. pyreniaca*, *Q. suber*, *Acacia mollissima*, *Pinus pinaster*, *Cedrus*. In the Rif, Middle Atlas and Central Plateau districts of Morocco.

Illustrations: This species has been illustrated in colour by Candusso & Lanzoni (1990 fig. 38c), Moreno, Manjon & Zugaza (1986, fig. 391); Pascual (1991, fig. 483), and as black and white habit sketches by Babos (1985, fig.); Kuyper & Schreurs (1983, fig.) and Malencon & Bertault (1970, fig. 19), Trimbach (1975, fig. 3).

Of these illustrations that of Pascual (l.c.) would appear to be slightly enlarged judged by the dimensions quoted in the accompanying text.

Distribution: *L. melanotrichus* has been reported from *North Africa*: Morocco: Rif, Moyen Atlas and Plateau Central - where it is said to be fairly frequent, although always dispersed on the ground in the maquis with *Cistus* spp., *Erica*, 'Myrtes' and *Arbutus* or in open forests of broad-leaved trees and conifers: *Quercus ilex*, *Q. pyreniaca*, *Q. suber*, *Acacia mollissima*, *Pinus pinaster* and *Cedrus* [Malencon & Bertault, 1970]. *Europe*: *Spain*: Eastern Spain: Casas de Millan (Cáceres) where it is said to be abundant in the extremely acidic evergreen oak woods of *Quercus ilex* ssp. *rotundifolia*; also noted as being the first record from the Spanish Peninsular [Moreno, Manjon & Zugaza, 1986].

Catalunya: Vespella de Gaia (Tarragones), amongst mosses and lichens with *Pinus halapensis* and evergreen oak. Said to be a common but poorly known species in Catalunya [Pascual, 1991]. Sardinia: Monte Limbara, in mixed woods of *Pinus* and broadleaved shrubs; Monte Pinu, with Pines and *Cistus* sp. (Candusso & Lanzoni, 1990).

France: South East: Alpes Maritimes: St. Paul en Forêt, Forêt Royale, where it is a typical species of the maquis during late autumn. It is said to be probably 'pas très rare' and to occur as single individuals (Trimbach, 1975). Netherlands: two records (Kuyper & Schreurs, 1983). The species has also been reported by Babos (1985) from glasshouses in Hungary and Finland.

Discussion: the account of the two Spanish gatherings by Moreno et al (1986) from Eastern Spain and Pascual (1991) from Catalunya in South West, match closely the original description of the North African material - although microscopic data is lacking from Pascual's text. Candusso & Lanzoni's (1990) account of the Sardinian fungus and Trimbach's (1975) account of French material from the Alpes Maritimes, also appear to be in agreement. All the above collections are from a maquis type habitat.

The Dutch collections described by Kuyper & Schreurs (1983) were from a quite different habitat, i.e. amongst needles of *Picea* and on leaves of *Dryopteris dilata* and *Alnus glutinosus*. In addition the fruitbodies were very small, with pileus 5-14 mm diam., and the spores had a range of (5.0-) 5.5-7.0 x 3.5-4.5 μ m, and were subamygdaliform, which is somewhat smaller than that of the Southern European collections. Likewise the collections from greenhouses in Hungary and Finland were also reported to have narrower spores 6.2-7.0(-7.8) x (3.0-) 3.2 - 3.9 μ m, than those of the specimens from North Africa and Southern Europe [6.0-8.0 x 3.8-5.0 μ m].

Leucoagaricus melanotrichus (Malenc. & Bertault) Trimbach var. **fuligineobrunneus** Bon & Boiff. Docum. Mycol. 8 (29), 33, 1978.

The following account is adapted from the original account by Bon & Boiffard in Bon (1978).

Pileus 10-15 mm. diam., fuscous to sooty-brown, especially at the disc, with a pale ochraceous-cream margin. *Stipe* 10-30 x 1.5-2.5 mm., with a pallid annulus lacking a black rim. *Microcharacters* as in the type variety.

This taxon was said to differ from the type variety in its smaller size. It was described as being relatively pale, with the pileus noted as not being black or with the pigmentation localized at the disc. The authors noted that it formed a transition toward *L. tener* (Orton) Bon in which the colour was indicated as more brownish-horn or russet.

This description was augmented by Bon (1981) as follows:

Pileus exceptionally reaching 20mm diam., flat to submamillate, grey-brown, relatively dark at the disc, flecked with blackish-brown or bluish punctations, paling towards the periphery to dull greyish-ochre or dirty white. *Stipe* 20-35 x 1-2(3) mm, equal or subclavate, silky white, with thin yellowish annulus. *Spores* (6.5-) 7.0-8.0 (-8.5) x 3.5 - 4.0 (-4.5) μ m, elliptic.

Habitat: Copses, grassy thickets, *Salix*, *Ulex*, *Rubus*, sometimes with conifers. Bon (l.c.) observed that this taxon is possibly less thermophilic than the var. *melanotrichus*. He also noted that var. *fuligineobrunneus* was perhaps intermediate between *L. tener* and *L. melanotrichus* var. *melanotrichus*.

Distribution: There are few records of this variety in the literature but they include the following: France, Western France, Penbron, Loire Atlantique (Bon & Boiffard in Bon, 1978). Northern France: : Saint-Valery-sur-Somme (Bon, 1988). Netherlands : Eastern Groningen (Bas, 1991).

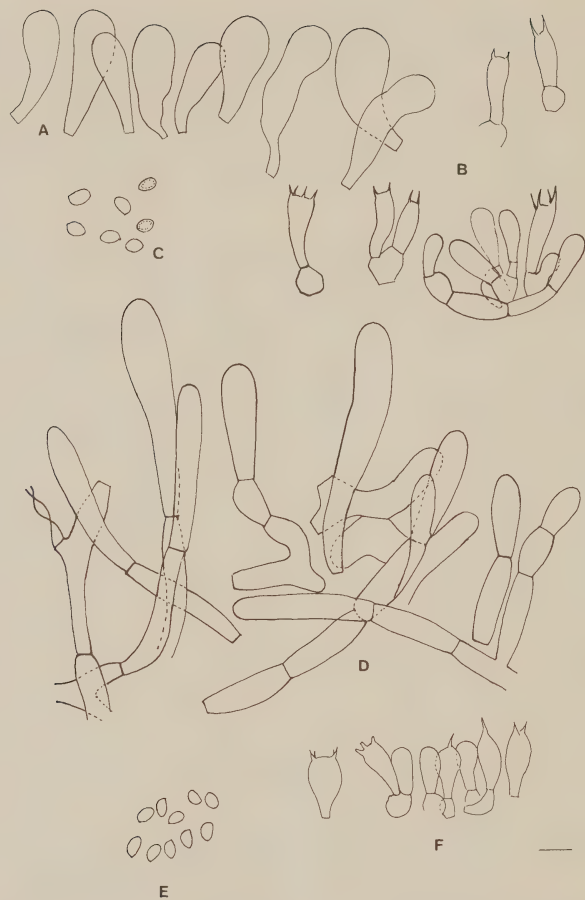


Fig. 1. A-F. *Leucoagaricus melanotrichus* var. *septentrionalis* A. Cheilocystidia. B. Basidia. C. Spores. D. Elements comprising the dark arachnoid fibrils on the pileus near the disc. All from the Sandy gathering. E. Spores. F. Basidia. Both from the holotype. Bar = 10 μ m.

Discussion: When Bon (1988) recorded *L. melanotrichus* var. *fuligineobrunneus* from Saint-Valery, he noted that a second collection from the same area had been found with small spores, having a range of $6.0(7.0) \times 3.5(4.0) \mu\text{m}$, which scarcely reached the lower limit of the typical range for this taxon.

In connexion with the small spores noted by Bon (1988) on a collection of *L. melanotrichus* var. *fuligineobrunneus* from Saint-Valery [$6.0(-7.0) \times 3.5(-4.0) \mu\text{m}$], it is interesting that Kuyper & Schreurs (1983) also noted small, subamygdaliform spores on a collection from the Netherlands which they referred to *L. melanotrichus* var. *melanotrichus* [ie' $(5.0) 5.5 - 7.0 \times 3.5 - 4.5 \mu\text{m}$].

From South East Britain there are two further gatherings which likewise possess small amygdaliform spores having a combined range of $5.0 - 6.5(7.0) \times 3.0 - 4.0 \mu\text{m}$.

While the total number of gatherings with small spores known to date is relatively few, it would appear that there is a microsporous taxon distinct from both *L. melanotrichus* var. *melanotrichus* and *L. melanotrichus* var. *fuligineobrunneus* - differing in the small size of its fruitbodies, its smaller spores and possibly in its preference for growing in dark situations heavily shaded by rotting vegetation. It may also have a more northern distribution in Western Europe. This is described below as *L. melanotrichus* var. *septentrionalis* var. nov.

***Leucoagaricus melanotrichus* var. *septentrionalis* Reid, var. nov.** Fig. 1A-F, Fig. 2A-B.

Pileus 9-12 (-15) mm diam., campanulatus dein explanatus, umbone parvo obtuso centrali instructus, non hygrophanus et non expallens, ad marginem laevis vel leviter striatus; primo pallide citrino-luteus, fibrillis arachnoideis radiantibus fusco-griseis et violaceo-tinctis vestitus; postea fibrillis magis dispersis et in squamas numerosas adpressas fusco-fibrillosas efformantibus, ad marginem pallidior et leviter plicatus, ad discum fusco-griseus. *Lamellae* liberae, albae, ad marginem fimbriatum guttulis aquosis lacrimantes.

Stipes 15-22 (-42) mm altus, 0.75 - 1.5 (-2.0) mm latus, basi bulbosus et 2-5 mm latus, omnino albus. *Annulus* membranaceus, albus, cum, vel raro sine, margine rufo-brunneo.

Sporae $5.0-6.5 \times 3.0-3.5 \mu\text{m}$, breviter amygdaliformae dextrinoideae sine poro germinativo. *Basidia* $15-20 \times 7(-10) \mu\text{m}$, hyalina, clavata, tenuiter tunicata et bispore vel quadrispora. *Cheilocystidia* $30-58 \times 8-14 \mu\text{m}$, abundantia, hyalina, subcylindrica, leviter clavata, elongato-lanceolata, vel fusiformia, et tenuiter tunicata. *Superficies pilei*

hyphis prostratis radialibus intertextis et tenuiter tunicatis formata; hae hyphae catenis brevibus segmentorum $4.5-9.0 \mu\text{m}$ latorum formatae, segmento ultimo plerumque longiore cylindrico vel leviter clavato, $5-10 \mu\text{m}$ lato. Hyphae omnino defibulatae.

In trunco prostrato putridissimo Laricis deciduae. Holm Fen National Nature Reserve, Middle Covert, Cambs. [GR.52/221888]. Sheila Wells, 14 Oct. 1990 [TYPUS in LJ].

Pileus 9-12(15) mm diam., campanulate then flattened with a low obtuse central umbo, non hygrophanous and non expallent. In the button stage very pale lemon yellow,

covered with an arachnoid web of radiating dark grey fibrils with a violet tint. On expansion of the cap, these fibrils become more and more dispersed away from the dark, slightly violaceous grey disc, giving the remainder of the cap a paler speckled appearance as more of the whitish flesh is exposed. Toward the smooth or slightly plicate margin, the cob-webby radiating dark fibrils gradually disappear. *Lamellae* free, white, with fimbriate margin, bearing numerous tiny glistening watery droplets. *Stipe* 15-22 (42) mm high, 0.75-1.5 (-2.0) mm wide, narrowing slightly upward and expanding below to a small bulbous base 2-5 mm wide, white throughout, densely covered with fine white threads, which readily collapse on handling leaving the surface silky striate, base of stem

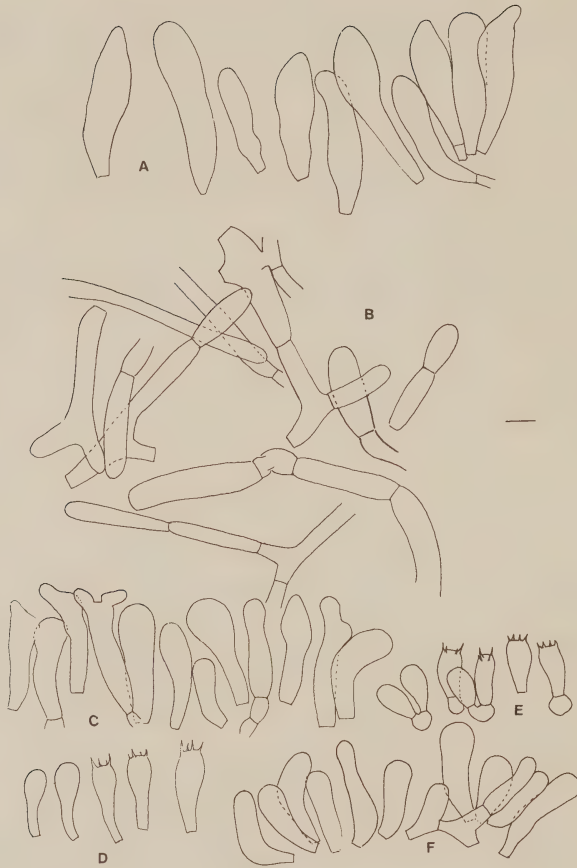


Fig. 2. A-B. *Leucoagaricus melanotrichus* var. *septentrionalis* A. Cheilocystidia. B. Elements comprising the dark arachnoid fibrils on pileal surface. Both from the holotype. C-F. *Leucoagaricus tener*. C. Cheilocystidia. D. Basidia. Both from the smaller specimen of the Littlehampton gathering. E. Basidia. F. Cheilocystidia. Both from the larger specimen of the same gathering. Bar = 10 μ m.

also with white cottony threads, but lacking all trace of coloured fibrils below the ring.

Annulus at about the mid-point of the stipe, membranous, delicate but persistent, initially upstanding, later horizontal, white, covered with fine white threads, and edged in most specimens, with a reddish brown mat of hairs. In the most perfect sporophore the hairs were definitely violaceous-grey. In other fruitbodies, including very young specimens, and also the larger fructification, there was no coloured edge to the annulus. *Flesh* white in cap, translucent white in stem. *Smell*: none, or perhaps slightly acidulous. *Spores* 5.0-6.5 x 3.0-3.5 μm , short amygdaliform, with a distinct dextrinoid wall, but lacking a germ pore. *Basidia* 15-20 x 7 (-10) μm , thin-walled, hyaline, clavate, lacking a basal clamp-connexion and arising from more or less isodiametric elements, 6-7.5 μm diam. These organs are either 2 or 4-spored, with 2-spored basidia predominant. *Cheilocystidia* 30-58 x 8-14 μm , abundant, thin walled, hyaline, varying from subcylindric or slightly clavate to elongate-lanceolate or fusoid. *Arachnoid fibrils on surface of pileus* formed of thin-walled, prostrate, entwined hyphae, with an overall radial orientation, forming short chains in which the lower elements are brown and cylindric, 4.5-9.0 μm diam., and the terminal elements usually longer, cylindric or slightly clavate 5-10 μm diam. All elements of the fruitbody devoid of clamp-connexions.

Habitat: On very rotten larch [*Larix decidua*] trunk, - the tree planted over 40 years ago - lying on the ground and overgrown by bracken [*Pteridium aquilinum*]. On acid peat.

Fruitbodies in small groups on the crumbling heart wood. Holme Fen National Nature Reserve, Middle Covert, Cambs. [Grid. ref. 52/221888], Sheila Wells, 14 and 21 October 1990.

A second British gathering has also been referred to *L. melanotrichus* var. *septentrionalis*. This was found at a site about 20 miles north of the type locality. It is described below.

Pileus 6-10 mm diam., shallowly campanulate, mouse grey, perhaps with a hint of purple, but fuscous black at the centre, in older specimens the surface disrupting into minute granular-punctate scales on a whitish background, the cap then appearing as if sprinkled with soot. Under a lens the scales are seen to consist of sparse prostrate blackish arachnoid fibrils, with a basic radial orientation. *Lamellae* free, white. *Stipe* 12-15 mm high, 1-1.5 mm wide, whitish, with a horizontal, similarly coloured but dark-edged annulus, below this the stipe covered almost to the base with dark arachnoid fibrils. *Texture* delicate. *Spores* 5.5-6.0 (-7.0) x 3.75-4.0 μm , amygdaliform, with a distinct dextrinoid wall, but lacking a germ-pore. *Basidia* 15-20 x 6-7 μm , thin walled, hyaline, clavate, with 4-sterigmata, lacking a basal clamp-connexion and arising from isodiametric slightly angular elements, 7-8 μm wide. *Cheilocystidia* 33-50 x 8-15 μm , abundant, thin-walled, hyaline, clavate, sometimes with a slight subapical constriction, and tapered toward the base. *Pleurocystidia* none. *Surface of pileus* of entwined, hyaline, thin-walled, septate hyphae, comprising chains of catenulate segments, 5-8 μm wide, often with "Y" shaped elements, and with the terminal segment usually more elongated, subcylindric, clavate or slightly narrowed at the apex, 33-50 x 8-15 μm . All elements lacking clamp-connexions.

Habitat: amongst damp rotting vegetation in deep shade, on sandy soil, The Lodge, Sandy, Bedfordshire, Peggy Hooper, 8 Nov. 1992.

Leucoagaricus tener (Orton) Bon, Docum. mycol. 27-28, 54, 1977. Fig. 2C-F, Fig. 3A-D.

Lepiota tenera Orton. Trans. Brit. mycol. Soc. 43, 288, 1960.

Pileus 15-24 mm diam., campanulate, disc dark brown, the remainder dusted with minute, radially adpressed, paler cobwebby fibrillose brown scales on a whitish or pale ochraceous ground; the scales fugacious toward the margin in young sporophores and sometimes disappearing entirely from the marginal zone in larger fruitbodies, and there indistinctly striate-sulcate. On handling the delicate fructifications bruised brown. *Lamellae* free, moderately crowded, whitish. *Stipe* 25-30 mm high, 1.5-2 mm wide, cylindric, whitish above the annulus, but dusted below with very minute cobwebby brown fibrils, barely visible to the eye. *Annulus* well formed, membranous, flaring upward, whitish, edged brown below. *Texture* delicate. *Spores* 6.0-8.0 x 3.2-4.0 (4.2) μm , from short amygdaliform to more elongated and narrowly elliptic to subcylindric, with a distinct wall becoming slowly dextrinoid, and lacking a germ-pore. *Basidia* 16-26 x 7-9 μm , thin-walled, hyaline, clavate, 4-spored, lacking a basal clamp-connexion, and arising from short angular, more or less isodiametric, or wedge-shaped hyphal segments.

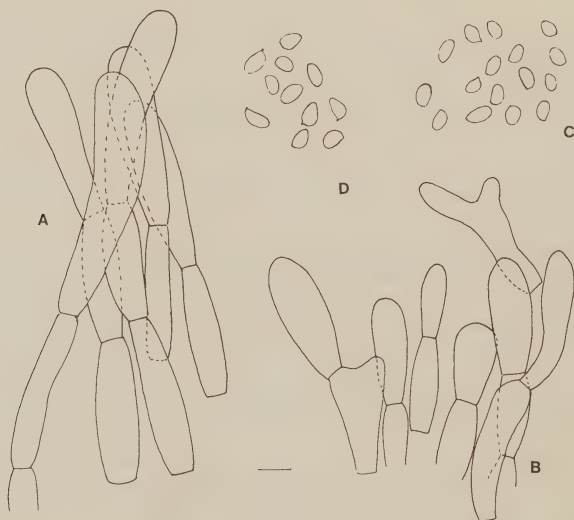


Fig. 3. A-D. *Leucoagaricus tener*. A. Elements comprising the dark arachnoid fibrillose scales on the pileus near the margin. B. As previous but showing elements forming the fibrillose scales near the pileal disc. C. Spores. All from the larger specimen of the Littlehampton gathering. D. Spores from the smaller specimen of the same gathering. Bar = 10 μm

Cheilocystidia 22-43 x 6-14 μm , abundant, thin-walled, hyaline, varying from clavate, sometimes with a very slight subapical constriction, to cylindric, or rarely to lageniform with a rounded apex or lanceolate, still more rarely with a short lateral prong or with up to two apical prolongations. These cheilocystidia are usually narrowed toward the base.

Pleurocystidia none. *Surface of pileus* at the disc formed of branching chains of short cylindric, thin-walled, segments to 60 μm long, and 7.0-16.5 μm wide, devoid of clamp

connexions at the slightly constricted septa, and readily dissociating; the terminal elements of these chains, 22-45 μm long, 7-15 μm wide, are either lanceolate, cylindric or clavate. There is a suggestion that, at the disc, these chains of segments have a vertical orientation. Away from the disc the fibrils of the scales are mostly formed of dissociated elements, although toward the margin their catenulate nature can sometimes be seen, and here the terminal element, to 50 μm long, and to 16 μm wide, is usually clavate.

Habitat: under *Ulex europaeus* and *Rubus fruticosus* agg., with ground cover of *Hedera helix*, in an isolated clump of bushes on Littlehampton Golf-course. D.A. Reid, B. Middleton, 1 Oct. 1993.

Illustrations: The species has been illustrated in colour by Candusso & Lanzoni (1990, fig. 38a); and by black and white habit sketches by Miglioizzi & Coccia (1990, figs. 2.4 - as a forma of the species), Orton (1960, figs. 107-108).

Distribution: *L. tener* is an uncommon species in Britain, but may be overlooked on account of its small size, and preference for growing in weedy places amongst such plants as *Glechoma hederacea*, *Urtica dioica*, *Hedera helix*, *Rubus fruticosus* and *Ulex europaeus*.

Apart from the British gatherings, *L. tener* has been reported from Netherlands (Uljé, 1984), France : Cournon (Candusso & Lanzoni, 1990), Germany: Gottenheim (Bon, 1976). Italy. Rome (Candusso & Lanzoni, 1990); Lazio (Miglioizzi & Coccia, 1990 as a forma of the species).

Discussion:

The above description of the Littlehampton material agrees closely with that of Orton's (1960) account of the type collection from Surlingham, Norfolk. This is especially true of the microscopic features. With regard to the macroscopic data, it is possible that Orton's material may have been slightly paler. In addition he noted that in wet weather his fungus 'sometimes' exuded yellowish droplets from the stem apex.

The Littlehampton collection comprised a group of three fruitbodies, in contact one with another, or almost so, growing in heavily shaded conditions under a small isolated clump of bushes, comprising gorse (*Ulex europaeus*) and bramble (*Rubus fruticosus* agg.) with a ground cover of ivy (*Hedera helix*). The fruitbodies are virtually certain to have been the product of the same common mycelium. It is, therefore, interesting to note the variation in microscopic data between the largest fruitbody, and one of the two smaller fructifications, as illustrated in figures 2C-F and 3A-D, especially with regard to the cheilocystidia and basidia.

A species closely related to *L. tener*, is one described from Morocco by Malencon and Bertault (1970) as *L. melanotrichus* (Malenc. & Bert.) Trimb. The latter differs from the species under discussion, chiefly in regard to the colour of the pileus, and in the somewhat broader, more elliptic spores. According to the original description the pileal surface was "fibrillo-laineux, apprimé, gris cendré à noir à reflet violeté ou parfois un peu vert bronze au début, bientôt, déchiré en flocons ou en fines méchules de plus en plus étirées et écartées vers les bords qui apparaissent pâles et mouchetés, non striés".

In all other macroscopic features *L. melanotrichus* matches those of *L. tener*. The spores of *L. melanotrichus*, however, were described as ellipsoid, 6.0-7.5 x 3.8-5.0 μm , exceptionally 7.8-9.0 x 4.6-5.4 μm , and were said to lack an obvious germ pore, although possessing "un cal sommital assez net".

Bon & Boiffard (1978) described a variety of this taxon viz. *L. melanotricha* var. *fuligineobrunneus*, which was said to differ from var. *melanotrichus* in its small size, the fuscous to sooty brown colour of the pileus especially at the disc, the margin paler

creamy-ochraceous, and the annulus lacking a dark margin. These authors noted that their new, relatively pale variety, formed a transition to *L. tener*, but that the latter possessed a more brownish-horn or russet colouring. Accordingly when Bon (1981) keyed out these three taxa, *L. melanotrichus* var. *melanotrichus* and var. *fuligineobrunneus* were classed as greyish to blackish or grey-brown species, whereas *L. tener* was classed with the fawnish-brown to chestnut species.

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THREE UNUSUAL BRITISH FUNGI

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Physalacria cryptomeriae Berthier & Rogerson, *Mycologia* **73**, 643, 1981.

Sporophores minute, stipitate-capitate, 500-800 μm high, with capitulum 250-400 μm diam., white, resembling scattered fruitbodies of a very tiny *Physarum*, which in the dried condition are of a pale cream colour. *Hyphal structure* monomitic. Hyphae of the stipe, 3-4(9) μm , thin-walled, hyaline, septate, lacking clamp-connexions, and with parallel, straight orientation, appearing agglutinated when examined in ammonia or 8% potassium hydroxide solution. The outermost hyphae are slightly narrower, and sometimes show small wart-like projections or pegs which may be the initials of caulocystidia, although well formed caulocystidia are also usually present. Hyphae of the capitulum similar but more highly branched and mostly about 3 μm wide.

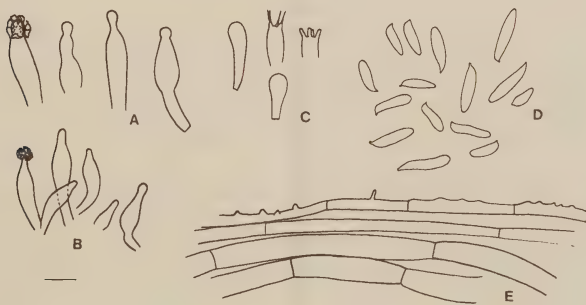


Fig. 1. A-E. *Physalacria cryptomeriae*. A Hymenial cystidia. B. Caulocystidia. C. Basidia. D. Spores. E. Hyphae from surface of stipe. Bar = 10 μm .

Hymenial cystidia 25-50 X 7-9 (10) μm , projecting slightly beyond the basidia as thin-walled, hyaline, lageniform or fusiform organs tapering toward the base, and with a subapical constriction, resulting in a subcapitate apex or papilla, 4-6 μm wide. These organs are conspicuously capped with a resin-like droplet to 10 μm diam., which is soluble in Melzer's solution and potassium hydroxide. *Caulocystidia* present on the stipe, and especially toward the base of many fruitbodies, resembling the hymenial cystidia, but smaller and with a less obvious subapical constriction, although similarly capped with resinous material. These organs are 15-30 μm long, with swollen base 6.5-8 μm diam., and apex 2.5-3.0 μm wide. *Basidia* 20-35 X 6 μm , thin-walled, hyaline, clavate, with 4 sterigmata. *Spores* 10.0-18.5 X 3.0-4.0 μm , thin-walled, hyaline, varying in shape from narrowly elliptic to navicular, and non-amyloid.

Habitat: On short fallen shoots of *Cryptomeria japonica* "lobbii", Westonbirt Arboretum, Gloucestershire, coll. Mrs. M.C. Clark, 4 Oct. 1975.

Distribution: *Physalacria cryptomeriae* was first reported from the United States, where it was growing on fallen needles of *Cryptomeria japonica* in the New York Botanic Garden. Here it grew on the fallen needles of trees varying in age from 76-41 years, but was found in greater abundance on the foliage of the oldest trees; all the trees originated either as seedlings from local nurseries or from seeds germinated at the garden.

The Westonbirt material represents the first British locality for *Physalacria cryptomeriae*. It has also been collected on mainland Europe from Lolland, Denmark (Laessoe & Spooner, 1993).

Discussion: The British material matches closely the original description of *P. cryptomeriae*. However, according to this the globose heads of the fruitbody are hollow.

In addition the authors distinguish between the presence on the stipe of hairs "either reduced as short and narrow protuberances and finger like or resembling small, capitate cystidia, provided with an apical droplet" and "Caulocystidia (10-) 20 (-30) X 4-6 μm at the summit 2-3 μm in diam with cyanophilic wall". In the description of the Westonbirt material no such sharp distinction is drawn between hairs and caulocystidia, since there appears to be complete intergradation between these organs. Finally in the type material clamp-connexions are noted at the base of both basidia and cystidia, as well as on the subhymenial hyphae, although lacking in the tramal tissue.

It should be noted that this same British collection was recently described by Laessoe & Spooner (1993), and in the main the two accounts tally well, but naturally there are slight variations in both macroscopic and microscopic measurements. However, these authors observed obtuse flexuous thin-walled excrescences arising from the hyphae of the stipe; these excrescences often with short side branches. They did not observe any thin walled fusiform or lageniform, resin-capped cystidia on the stipes similar to the hymenial cystidia.

Berthier & Rogerson (1981) in their original account of *P. cryptomeriae*, compared it with other species belonging in the genus including *P. clusiae* to which taxon it would key in Corner's (1950) 'Monograph of *Clavaria* and Allied Genera'. However, in the latter work *P. clusiae* is only very briefly described and there is no mention of the presence or absence of clamp-connexions. Berthier & Rogerson (l.c.) reported that clamp-connexions are totally lacking in this species, in contrast to *P. cryptomeriae* where they are found at the base of the hymenial organs and at the septa of the subhymenial hyphae. Further, the stipe of *P. clusiae* was said to be "destitute of caulocystidia" and bears only "undifferentiated, or sometimes digitate hairs". *P. indica* Chandrashek & Natraj. was also said to lack clamp-connexions, but has thick-walled cystidia and very small spores 2.5-4.0 X 2.0-2.5 μm .

Physalacria stilboidea (Cooke) Sacc. Syll. Fung. 9, 256, 1891.

Pistillina stilboidea Cooke, Grevillea 19, 2, 1890.

Sporophores stipitate-capitate: *capitulum* 300-750 μm diam., white when fresh, drying pale cream, globular, often slightly flattened or concave below, sometimes with a slight rounded marginal rim beneath, and sometimes slightly radially plicate around the stipe apex. *Stipe* 500 - 1000 μm high, to 60 μm wide at the apex expanding to 80 μm wide at the base, concolorous. Both the capitulum and stipe appearing glabrous under a X 10 hand lens but under very high magnification appearing bristly with projecting hymenial - and caulocystidia. *Hyphal structure* monomitic. Hyphae of stipe parallel, agglutinated, 2.5-6.5 (-8.0) μm wide, with thickened refractive walls, mostly lacking clamp-connexions at the septa, but in some fruitbodies with occasional clamps, especially on the superficial hyphae. The latter are less regularly arranged, less agglutinated, more variable in width, 6-8 μm wide, more frequently septate, and often somewhat sinuous, with frequent 'H' connexions. These superficial hyphae develop wart-like outgrowths or short finger-like protuberances which grade into caulocystidia. Subhymenial hyphae 2.5 μm wide, thin-walled, with clamp-connexions which tend to be loop-like. *Hymenial cystidia* 45-60 X 6-9 μm , fusoid, tapering above to a narrow, acute or subacute resin-capped apex, 2.0-3.5 μm diam., and below to a clamp-bearing basal septum; these organs with thickened walls thinning to both base and apex, and projecting to 35 μm beyond the basidia. *Caulocystidia* abundant similar to the hymenial cystidia but smaller, and like them resin-capped and with thickened walls, 25-35 X 6-11.6 μm , fusoid to lageniform to almost pyriform or lanceolate, with an acute or subacute apex, but usually lacking a basal clamp-connexion. At the base of the stipe of one of the several sporophores studied there were very abundant elements with thickened walls ranging from clavate, 15-38 X 18-20 μm , to ovate or subglobose 25-30 X 18-20 μm . *Basidia* 34-41 X 6-7 μm , thin-walled, hyaline more or less clavate to suburniform, with a slight constriction above the base, 4-spored, with a basal clamp-connexion. An abnormal basidium seen with one normally positioned sterigma and the remaining 3 borne on a narrow apical extension. *Spores* 9.0-14.5 X 3.5-5.5 μm , thin-walled, hyaline, varying from narrowly elliptic to lacrymoid.

Habitat: On unidentified leaves, Sharpitor Gardens, Salcombe, South Devon, J. Webster, 15 Sept. 1979.

Discussion: Regarding the identity of the host, the collector wrote (in litt.) 'I suspect that the leaves might belong to *Hedera*, but there are indications that the fungus is not host specific, because I also have it on different leaves, possibly those of *Drimys winteri*'. When informed that the fungus was *P. stilboidea* - a species originally described from New Zealand on leaves of *Panax*, Prof. Webster informed me that Sharpitor Gardens contain a number of New Zealand plants including *Nothospartium*, and he expressed the view that the fungus may have been introduced on, or with these plants.

Laessoe & Spooner (1993) have published an account of the Sharpitor material, and in the main there is agreement between their description and that outlined above. However, there are discrepancies since they describe both the hymenial and caulocystidia as subcapitate and capitate respectively, whereas I find them to be fusoid and pointed. Another and more important difference involves the distribution of clamp-connexions. In the above-account clamps are noted at the base of basidia, and hymenial cystidia and also at the septa of the subhymenial hyphae. They were not normally present on the hyphae of the stipe or at the base of the caulocystidia. Laessoe and Spooner (l.c.) however, noted 'clamp-connexions present in all tissues'. Nevertheless in their illustration (fig 1k) clamps are not shown at the base of the caulocystidia or at the septa

of the hyphae of the stipe.

Campanella inquilina Romagnesi, in Redhead, Can. Jl. Bot. **62**, 881, 1984.

Leptoglossum galeatum W.B. Cooke, Beih. Sydowia **4**, 131, 1960 [Nomen invalid.]

Campanella europaea Sing. Nova Hedw. **26**, 873, 1975 [Nomen invalid.]

Misapplied Name:

Campanella conchata (Vel.) Romag. sensu Romagnesi non Velenovsky, Bull. trimest. Soc. mycol. Fr. **96**, 426, 1980.

Fruitbodies 2-8 mm. diam, sessile, flattened discoid with free margin; pendulous and cupulate, or alternatively laterally attached and dimidiate or galeate, white and remaining so on drying or becoming pallid greyish buff or grey; surface minutely scurfy fibrillose, smooth or bullate. **Hymenophore** lamellate, white, with 2-6(8) well formed blunt lamellae. **Lamellae** radiating from a centric or excentric point, simple or bifurcating either close to the central point or frequently near the margin, sometimes with cross connexions and appearing almost angularly poroid. **Flesh** gelatinous. **Spores** 7.75-10.5 X (4.0) 4.5-5.5 μm , elliptic to amygdaliform, distinctly apiculate, thin-walled, hyaline, non-amyloid and non-dextrinoid. **Basidia** 35 - 45 X 8 μm . thin-walled, hyaline, clavate, 4-spored, with a basal clamp connexion. **Basidioles** variable in both prominence and frequency, 20 - 40 X 4 - 6 μm thin-walled, hyaline, fusoid, with a more or less pointed or bluntly rounded apex and a basal clamp-connexion. **Cheilocystidia** forming a dense sterile margin to 50 μm wide. These elongated organs are 35-45 μm long, with slightly thickened non-dextrinoid refractive walls, an irregular often almost geniculate base, 2.5-4.5 (-7.0) μm wide, bearing conspicuous diverticulate processes to 3.5 μm in length, and short nodular outgrowths, which also bear diverticulae. Each organ is prolonged into a smooth, apical club-shaped structure terminating in a subcapitate tip 4-8 μm wide.

Pleurocystidia absent. **Context and trama** gelatinized, of thin-walled, hyaline, agglutinated hyphae, 2.75-3.3 (4.0) μm wide, with clamps connexions at the septa, and non-dextrinoid, non congophilous walls; the clamps often somewhat swollen or loop-like.

Epicutis : towards the surface of the pileus the clamp-bearing hyphae 2.7-3.3 μm wide become progressively less agglutinated and divergent. They have thin but distinct walls and give rise to dermatocystidia similar to the cheilocystidia but on average shorter, 25-45 μm long, with heads to 6.6 μm wide. **Subhymenium** distinct, of thin-walled, hyaline, entwined, clamp-bearing hyphae, 2.5-3.0 μm wide.

Habitat at the base of damp culms of *Ammophila arenaria*, on open sand dunes, Littlehampton Golfcourse, West Sussex, D.A. Reid, 1 Oct. 1993.

Occurrence & Distribution: On living or dead grass culms, usually amongst the damp, standing basal debris, but sometimes occurring fairly high up on living plants (Bon 1987).

Occurrence in sand dunes on *Ammophila arenaria* seems a particularly favoured habitat. The Littlehampton gathering represents the first report of its occurrence in the British Isles. Elsewhere it would seem to be known only from Netherlands, France, and North Africa close to Tangier. From these countries it was variously reported as *Leptoglossum conchatum*, *Campanella conchata* and *C. europaea*, as well as *C. inquilina*.

Discussion: *Campanella inquilina* was initially keyed out and briefly described by Kuhner & Romagnesi (1953) as *Leptoglossum conchatum* Vel. Subsequently Malencon & Bertault (1975) published a detailed account of the same species under the name *Campanella conchata* based on material collected from near Tangier. More recently Romagnesi (1980) provided a comprehensive account of French material collected at Chapelle-en-Serval, using the epithet *Campanella conchata* (Vel.) Romag., while Bon (1987)

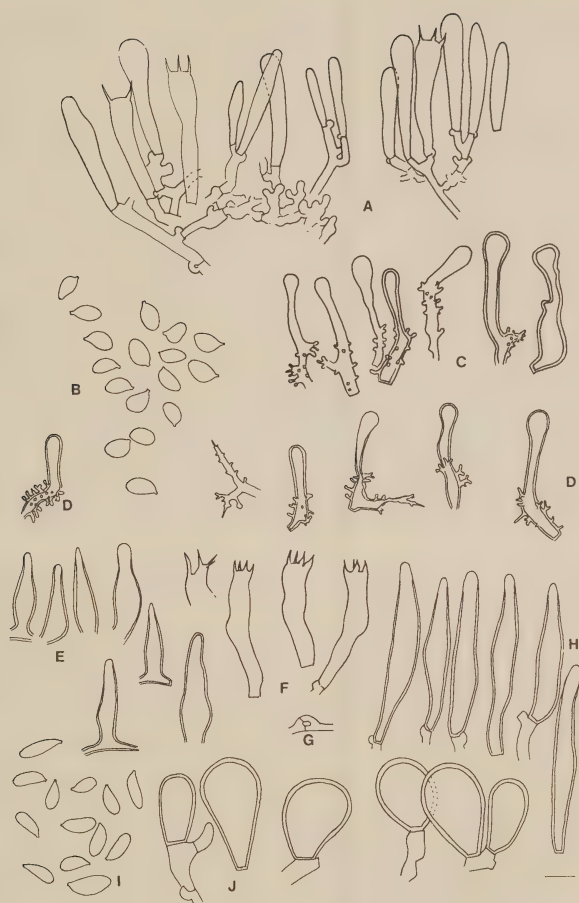


Fig. 2A-D *Campanella inquilina*. A. Basidia, basidioles and subhymenial hyphae. B. Spores. C. Cheilocystidia. D. Dermatocystidia. E-J *Physalacria stilboidea*. E. Caulocystidia. F. Basidia. G. Loop-like clamp on subhymenial hypha. H. Hymenial cystidia. I. Spores. J. Clavate, ovate and subglobose elements from the base of the stipe from one of the fruitbodies. Bar = 10 μ m.

described gatherings from Stella-plage and Merlimont, Pas de Calais as *C. inquilina*. However, Redhead (1984) pointed out that the type of *Leptoglossum conchatum* represented a specimen of *Arrhenia retiruge* [Bull.:Fr.] Redhead [= *Leptoglossum retirugum*], leaving the species discussed above requiring a name. This was provided by Romagnesi (in Redhead 1984) who named the taxon *Campanella inquilina* Romag. and gave a latin diagnosis based on his description of *C. conchata* published in 1980.

The description of the Littlehampton collection is in very close agreement with the account of the North African gathering published by Malencon & Bertault (1975) and likewise with Bon's (1987) description of the French material from the Pas de Calais, which was also growing on *Ammophila arenaria*. However, it agrees less closely with Romagnesi's (1980, 1984) circumscription of *C. inquilina*, but the differences are possibly only of degree rather than of a fundamental kind. According to Romagnesi the spores measured 7.0-8.0 X 3.5-4.0 μm , which is narrower than those of the Littlehampton material and of the North African material described by Malencon & Bertault (l.c.), and of the French gatherings described by Bon (l.c.). As illustrated by Romagnesi they appear more elongated and more narrowly amygdaliform to almost navicular; this could be due to immaturity. Further the cheilocystidia were shown without diverticulae, although he noted that they were 'parfois avec amorces de ramifications obtuses on de contours sinuolés vers la base'. However it remains to be seen if there is but a single species, or more than one species growing on damp grass culms in Western Europe & North Africa. Further research is needed.

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***Cortinarius bisporus* spec. nov. a new toxic species
in Sardinia (Italy)**

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Abstract - A new species of *Cortinarius* subgen. *Leproclybe* from Sardinia is described. The new species is distinguished by its bisporous basidia and subglobose spores and grows in the Mediterranean forest with *Quercus*. HPLC analysis has shown presence of orellanin, a nephrotoxic substance, as well as other psychoactive alkaloids.

In spite of very important contributions (MOENNE-LOCCOZ & REUMAUX, 1990-1993; BRANDRUD et al. 1991; TARTARAT, 1992), the genus *Cortinarius* is still very complex both from the systematic and the taxonomical and toxicological point of view. Research, though valid, has only partly solved the taxonomical complications, the main reason being that new species are found continuously. Toxicologically speaking, we are far from solving the problems associated with the nephrotoxicity of some *Cortinarius*, which cause serious kidney diseases.

These were the problems we had to face when we found a new species in Sardinia, *Cortinarius bisporus* (Figure 1). Apart from its taxonomical framing, we have considered it both useful and necessary to investigate its possible toxicity, considering its high incidence in macromycete poisoning caused by the genus in Sardinia. Studies have shown that these manifestations are present in about 12-14% of all the cases found in Sardinia.

Systematic observations

Information on the ecology and diffusion of the genus *Cortinarius* in Sardinia is scanty, despite the diverse contributions (HENRY & CONTU, 1985; 1986; 1988; CONTU, 1988). During intense research on the microflora of holm oak forests (BALLERO and CONTU, 1987) we repeatedly observed a species, well-characterized both macromorphologically and micromorphologically. Since these characteristics did not coincide with other known species, we considered it important to propose it as a new species. The nomenclature adopted by MOSER (1986) was followed. The exsiccata are preserved in the mycological section of the Herbarium of the Institute of Botany of the University of Cagliari (CAG).

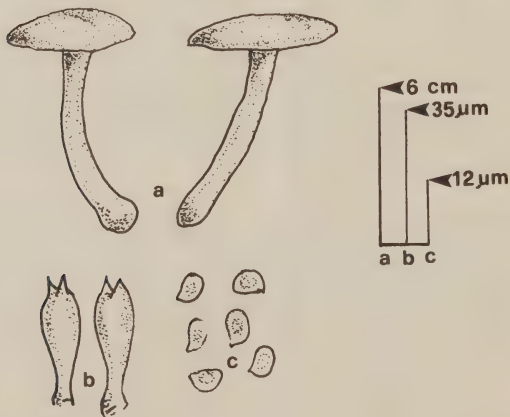
Cortinarius bisporus spec. nov.

Pileus 3-6 cm latus, expansus, ad medium late obtuseque umbonatus, haud hygrophanus, siccus, radialiter fibrillosus, flavo brunneus. Lamellae luteae, subdistantes, emarginatae, flavo brunneae dein leviter obscuriores, acies pallidior, serrulatae.

Stipes 4-6.5 x 0.4-0.6 μm , cylindraceus, ad basim leviter inflatus, siccus, fibrillosus vel striolatus, ad medium cum vestigia araneosa. Caro alba, sericea, immutabilis; odor saporque debilis, raphanaceis. Sporarum pulvis ferrugineo-brunnea. Sporae 7.5-10(12) x 6-8.2 (10.5) μm , brunneae, subglobosae vel latae ellipsoideae, verrucosae, monoguttulae. Basidia 25-40 x 7-9 μm , mono vel bispora, rara trispora, clavata, fibulata. Cellulae marginales incospicuae vel clavatae 9-10.5 μm lata. Pilei cutis haud gelata ex hyphis intertextis, cylindraceis, 3-10.5 μm latae, constituta, pigmento intracellularis vel intraparietalis. Hypoderma cellularis. Fibulae praesentes.

Habitat - Mediterraneensis, in nemoribus frondosis cum quercubus; autumnno. Species infrequens.

Typus: Sardinia, prov. Cagliari, Guasila. 15.11.1992. Legit et Determinavit M. Contu. (CAG: 5/8.23)

*Cortinarius bisporus* spec. nov.

a) carpophores b) basidia c) spores

Pileus 3-6 cm, expanded usually with a wide and obtusely bossed centre; non-hygrophanous, dry cuticle, radially

fibrillous, yellow brown, slightly darker in the centre. Lamellae wide, thick, emarginated, yellow brown getting darker, slightly paler crenulated uneven edges. Stem 4-6.5 x 0.4-0.6 cm, cylindrical, slightly wider at the base, filled, dry, fibrillous or slightly striated, of the same colour as the pileus, white towards the base due to the mycelium. Scarce curtain-like veil, brownish, reduced to remnants in the median part of the stem. Not too firm, white context, constant, silky; mild radish-like smell and taste. Spore-print rust brown.

Spores 7.5-10(12) x 6-8.2(10.5) μm , brown, subglobose or widely ellipsoidal, heavily verrucose, with a large central drop, small apex clearly visible. Basidia 25-40 x 7-9 μm , mono and bisporous, very rarely trisporous, clavated, with clamps at base. Poorly differentiated, inconspicuous or clavated marginal cells, 9-10.5 μm wide. Pileal surface non gelatinized, made up of a weave of cylindrical 3-10.5 μm hyphae, with intracellular and intraparietal pigment; hypodermium cellular all hyphae have clamps connections.

Habitat: solitary or in small groups, at times in the moss in holm oak and/or cork-oak woods. Autumn; rare and so far known only in Sardinia. Studied material: Guasila, province of Cagliari, ilex grove. 15.11.1992 M. Contu (CAG: 5/8.23 typus); Marganai, province of Cagliari, ilex grove, 6.11.1992 M. Ballero (CAG: 5/8.24); Marganai, province of Cagliari, ilex grove 29.10.1993 M. Ballero (CAG: 5/8.25).

Toxicological observations

HPLC analyses were carried out on fresh material according to the technique reported by TEBBET & CADDY (1984). This research has shown presence of traces of carbonylic alkaloids such as infractin, 6-hydroxyinfractin, infractopicrocin, as well as more significative traces of cortinarin A and cortinarin B, which have been isolated by ANTKOVIK and GESSNER (1979). Our chemical analysis did not show any signs of cortinarin C, which was detected by AZEMA (1993) in some genera of *Cortinarius*.

The carbonylic alkaloids are psychoactive like armalin (SAMORINI, 1993), while cortinarin A, better known as orellanin (3-3', 4-4'-tetrahydroxy 1-1' dioxy 2-2' bipyridin) is not yet well characterized chemically, and is responsible for the important enterogastric symptomatology and acute renal insufficiency that are manifest from 2 to 17 days after its uptake (ROVATI et al., 1989; RUEDL et al., 1990; PFALLER et al., 1991). The observations made by ANDARY et al. (1986) and PRAST et al. (1988) have shown that orellanin is deactivated by light, is resistant to cooking, pH variations and exsiccation, and is slow-acting. Substance B should not prove harmful and should not contribute to the process of intoxication. TEBBET & CADDY (op. cit.) state that the toxicity of the *Cortinarius* genus seems proportional to the combination, concentration and interaction of these two substances.

Conclusions

C. bisporus is the second species of the *Cortinarius* genus with only bisporous basidia, to be found in Sardinia. The species described earlier by CONTU (1992), *C. bisporiger*, was another entity, and was typical of formations of *Eucalyptus* sp. pl.. It is evident that the only analogy between the two species is the bisporous basidia. In fact while *C. bisporiger* Contu belongs to the *Phlegmacium* (Fr.) Fr. subgenus, *C. bisporiger* belongs rather to the *Leprocye* Moser subgenus, as seems to be confirmed by the globose shape of the spores, which is totally atypical of *Dermocybe* (Fr.) Wünsche [= *Cortinarius* Fr. *Dermocybe* (Fr.) Fr. tribe], even though certain carpophores do look like this genus. Within its own subgenus the species is easily recognized by its yellow-brown colour, and micromorphologically speaking, by its subglobose or globose spores and its basidia, which are always mono or bisporous. The marginal cells are almost completely inconspicuous and may be considered practically null. We did not find anything similar in the quoted literature. The species, moreover, is not identifiable from the clues available. Among the species belonging to the *Leprocye* subgenus with subglobose spores, *C. melinus* Britz. has sharp olive-coloured shades in its lamellae and a clearly visible veil, while the species ascribed to the *Dermocybe* genus, such as *D. crocea* (Schaeff.: Fr.) Wünsche, whose colours are very similar, have very different, non subglobose spores.

Chemical observations on *C. bisporus* have pointed out traces of orellanin. For this reason this species can be considered potentially toxic and therefore to be ascribed to the poisonous group of *Cortinarius*. More specific and detailed toxicological investigations are necessary to evaluate the risk level of this species, together with a general revision of the toxicity of the *Cortinarius* genus. It has been proved now that the poisonous genera belong to many subsections of several subgenera [*Phlegmacium* (Fr.) Fr., *Sericeocybe* Orton, *Telamonia* (Fr.) Loudon, *Leprocye* Moser] and not only to the *Orellani* Moser section as suggested by AZEMA (op. cit.). Such careful specification would stop serious doubts and confusion with edible species of the same genus. It is not rare, moreover, to confuse *Cortinarius*, characterized by presumed or uncertain toxicity, with edible species of different genera (MAZZA, 1989).

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FUNGI ON *JUNCUS ROEMERIANUS*. I. *TRICHOCLADIUM MEDULLARE* SP. NOV.

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ABSTRACT

Trichocladium medullare sp. nov. is one of the most frequent hyphomycetes on saltmarsh *Juncus roemerianus* in North Carolina. The new fungus can be found throughout the year in the lower part of standing dead culms. A key to the marine and freshwater species of *Trichocladium* is presented and the new combination *Trichocladium alopallonellum* comb. nov. (basionym *Humicola alopallonella*) is proposed.

INTRODUCTION

Juncus roemerianus Scheele is most prevalent in salt marshes of the South Atlantic and Gulf Coasts of the eastern United States, and covers almost 50% of the coastal marshes in North Carolina (Eleuterius 1976). Our survey of the mycota of salt marsh plants of the Atlantic coast of the U.S.A. has resulted so far in the description of 5 marine or halotolerant ascomycetes from *J. roemerianus* in North Carolina (Kohlmeyer & Volkmann-Kohlmeyer 1993a,b, Volkmann-Kohlmeyer & Kohlmeyer 1994). In the following we describe the first marine hyphomycete on *J. roemerianus* which occurs frequently on dead culms in North Carolina.

Trichocladium medullare Kohlm. & Volkm.-Kohlm., sp. nov.

Etymology: From the Latin, *medulla* = pith, and the suffix *-aris*, in reference to the growth of the species in the parenchymatous cells of the pith in *J. roemerianus*.

Hyphae hyalinae ad dilute brunneae, septatae, ramosae; **conidia** e hyphis aut e cellulis conidiogenis lateralibus brevibus evolutis; didyma; cellula apicalis magna, ellipsoidea, rariter nephroidea, fusca, 13.5-20.5 μm longa, 7-10 μm diametro ($\bar{x}$ = 16.2 x 8.4 μm , n = 46); cellula basalis (rariter bini) parvula, cylindrica vel obconica, raro dolliformis, dilute brunnea, plerumque

ad angulum exiguum patens, 3.5 - 6.0 μm longa, 3.0 - 5.0 μm diametro ($\bar{x}$ = 4.8 x 3.9 μm , n = 35).

SUBSTRATUM: Culmi senescenti *Junci roemeriani*

DISTRIBUTIO: Oceanus Atlanticus (America Septentrionalis)

HOLOTYPE: J.K. 5523 (IMS); ISOTYPE: J.K. 5523 (NY)

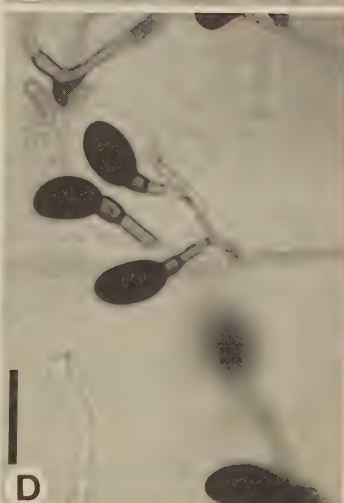
Hyphae hyaline to light brown, septate, branched. **Conidia** developing directly on hyphae or on non-specialized short lateral conidiogenous cells which resemble vegetative hyphae; two-celled; with a large ellipsoidal, rarely kidney-shaped, fuscous apical cell and one (rarely two) small cylindrical or obconical, rarely barrel-shaped, light brown basal cell(s); lower cell mostly forming a slight angle with the upper cell; the apical cell is 13.5-20.5 μm long and 7-10 μm in diameter ($\bar{x}$ = 16.2 x 8.4 μm , n=46), the basal cell 3.5-6.0 μm long and 3.0-5.0 μm in diameter ($\bar{x}$ = 4.8 x 3.9 μm , n=35); conidia formed on saltwater-agar media have similar dimensions, with means of 15.0 x 8.7 μm for the apical cells and 4.0 x 3.7 μm for the basal cells.

Material examined: Dead standing culms of *Juncus roemerianus*, Broad Creek, Carteret County, North Carolina 34°43'N, 76°55'07"W, 31 Dec. 1993, J.K. 5523 (holotype: IMS, also in pure culture; isotype: NY); same host and location, 1 July 1975 (J.K. 3660), 2 Aug. 1975 (J.K. 3661), 1 Aug. 1977 (J.K. 3848), 6 Jan. 1978 (J.K. 3893), 18 Nov. 1992 (J.K. 5486), 20 Dec. 1992 (J.K. 5491), 31 Jan. 1993 (J.K. 5493), 7 Feb. 1993 (J.K. 5496), 4 and 6 Apr. 1993 (J.K. 5504, 5505), 20 June 1993 (J.K. 5509), 8 Aug. 1993 (J.K. 5517), 13 Oct. 1993 (J.K. 5520), 30 Jan. 1994 (J.K. 5524), 13 Feb. 1994 (J.K. 5525); same host, Ward Creek, Carteret County, North Carolina, 34°46'46"N, 76°34'30"W, 29 Apr. 1993 (J.K. 5507), 3 Sept. 1993 (J.K. 5519).

Conidia of *Trichocladium medullare* are frequently found on walls of parenchymatous cells of pith in old culms of standing *Juncus roemerianus*. In one collection (J.K. 5524) it was growing and sporulating profusely on a dead insect larva embedded in the culm. The fungus occurs from the rhizome, up to 44 cm (rarely up to 52 cm) height, and is most active in broken-off and softened culms. Apparently, in nature it is an aggressive cellulose decomposer. It covers a saltwater-agar plate within a few days and sporulates abundantly, also on cellophane, balsa wood, snake skin, *Uniola* spikelets and alfalfa stems in yeast-peptone-seawater. We have encountered *T. medullare* throughout the year in our monthly collections in North Carolina. So far, we have found it only in *J. roemerianus*, and not in associated marsh plants (e.g. *Spartina alterniflora* Lois.)

Fig. 1. *Trichocladium* spp. conidia. (A) *T. alopallonella* (Type Herb. F of *Humicola alopallonella*).

B-D. *T. medullare* (Type herb. IMS). (B) On pith cells of *Juncus roemerianus*. (C) Conidial ontogeny, from culture. (D) Mature conidia from culture. (All scales = 20 μm).



Conidia of the new species resemble those of the ubiquitous marine hyphomycete *Humicola alopallonella* Meyers et Moore (Kohlmeyer & Kohlmeyer 1979). The main differences between the two species are fuscous, elongate ellipsoidal apical cells with a mean length of $16.2\ \mu\text{m}$ and a diameter of $8.4\ \mu\text{m}$ in *Trichocladium medullare* versus reddish-brown, subglobose to ellipsoidal apical cells with means of $10.8 \times 8.6\ \mu\text{m}$ in conidia from nature in *H. alopallonella*. In culture the morphology of conidia of *H. alopallonella* varies considerably and the cells become much larger (Fig. 1A) than in the natural habitat (Kohlmeyer 1969). However, conidia of *T. medullare* developed in culture (Fig. 1C,D) do not differ essentially from those grown in nature (Fig. 1B). The two species appear to be congeneric, but cannot be included in the genus *Humicola* Traaen as circumscribed by Ellis (1971) and Carmichael *et al.* (1980). De Bertoldi *et al.* (1972) and Lepidi *et al.* (1972) had already stated that *H. alopallonella* should not be referred to *Humicola* because conidia of the type species and other representatives in this genus are one-celled. The closest genus is *Trichocladium* Harz and the following transfer is proposed:

Trichocladium alopallonellum (Meyers & Moore) Kohlm. & Volk.-Kohlm., comb. nov. (basionym: *Humicola alopallonella* Meyers & Moore, Amer. J. Bot. 47:346, 1960).

The following key will assist in the identification of marine and freshwater species (Crane & Shearer 1978) of *Trichocladium*.

Key to the aquatic species of *Trichocladium*

- 1 Conidia up to $55\text{--}58\ \mu\text{m}$ long; a freshwater species *T. moenitum* Crane & Shearer
- 1' Conidia usually less than $35\ \mu\text{m}$; marine or brackish water spp. 2
 - 2 (1') Conidia never more than 3-celled 3
 - 2' (1') Conidia with 3 or more cells 5
- 3 (2) Apical cell elongate ellipsoidal or kidney-shaped; on *Juncus* *T. medullare*
- 3' (2) Apical cell subglobose to ellipsoidal or obpyriform; on wood 4
 - 4 (3') Conidia 2-3-celled, base curved; apical cell dark brown to black *T. linderi* Crane & Shearer
 - 4' (3') Conidia 2-, rarely 3-celled, straight; apical cell reddish-brown *T. alopallonellum*
- 5 (2') Conidia slightly constricted at septa, light brown; apical cell usually up to 14 (rarely $17\ \mu\text{m}$ diam *T. lignincola* Schmidt
- 5' (2') Conidia strongly constricted, dark brown; apical cell up to $20\ \mu\text{m}$ diam. or more 6
 - 6 (5') Cells subglobose, reddish-brown *T. constrictum* Schmidt
 - 6' (5') Cells compressed, not reddish *T. achrasporum* (Meyers & Moore) Dixon

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Abstract — *Sphaeria acuta* Hoffm. has been used as basionym for anamorph and teleomorph of different species of *Leptosphaeria*. A plausible lectotype is chosen according to the sanctioning protologue, viz. Sclerom. suec. Fasc. 4, No. 118 in UPS. Therefore this epithet is tied to the *Phoma* anamorph of *Leptosphaeria doliolum* (Pers. : Fr.) Ces. & de Not. subsp. *doliolum*, identical with *Phoma hoehnelii* var. *urticae* Boerema & van Kest. apud Boerema (1976). The teleomorph name *Pleospora acuta* must be regarded as newly introduced by Fuckel (lectotype: Fungi rhen. No. 900 in G) and transferred to *Leptosphaeria* by Karsten.

Sphaeria acuta Hoffm. has been applied to anamorphs and a teleomorph of various species of *Leptosphaeria* causing a chaotic situation of nomenclature, see Boerema (1976). In a recent 'nomenclator' of *Leptosphaeria* species (Crane & Shearer, 1991), the teleomorph species commonly occurring on dead stems of *Urtica* spp. is listed as *L. acuta* (Hoffm. : Fr.) P. Karsten, i.e. as based upon *Sphaeria acuta* Hoffm. : Fr.. This is in conflict with some historical facts. In this paper we try to clarify the nomenclature of the fungi under consideration. For descriptions see Boerema (1976) and Boerema & Loerakker (1981).

Sphaeria acuta Hoffmann (1787) was interpreted by subsequent authors, i.a. by Fries, in several ways. Therefore Boerema (1976) suggested that the binomial be rejected as a 'nomen ambiguum'. Because of the special sanctioned status attributed to names recognized by Fries and its consequences for lectotypification, it has become possible to settle the identity of *Sphaeria acuta* Hoffmann *sensu* Fries by tying it to one of the specimens examined by Fries. Consequently we find that *S. acuta* can only be based on a *Phoma* anamorph commonly occurring on dead nettle stems, which has often erroneously been associated with the above-mentioned *Leptosphaeria acuta*.

The history of *S. acuta* can be summarized as follows:

— *Sphaeria acuta* Hoffmann (1787), according to the original description and figure, is a long-beaked *Phoma*/*Sphaeronaema*-like anamorph, found on twigs and wood.

— Persoon (1799, 1801) seems to be the first to apply the name to long-beaked fruiting-bodies of fungi growing on herbaceous, particularly *Urtica*, stems. His description may equally point to an anamorphic or a teleomorphic fungus.

— Fries (1823), apparently following Persoon, also applied the name to long-beaked fruiting-bodies on *Urtica* spp. From his description it can also not be decided whether he was dealing with an anamorph or a teleomorph. The specimens which he cited and which are preserved at Uppsala (UPS), turn out to contain exclusively and abundantly the *Phoma* anamorph growing on nettles. This concerns Sclerom. suec. No. 118, two other specimens in Fries' herbarium, and the UPS copy of Mougeot & Nestler's Stirp. Crypt. No. 181, cited with "!" and labelled *Sphaeria acuta* 'Pers.' (cf. Nannfeldt, 1939). Originals of the Mougeot & Nestler No. 181 in PC (herb. Mougeot) also turned out to contain abundant pycnidia of the *Phoma* anamorph. The interpretation of this taxon as an anamorph also fits better with the original description by Hoffmann.

It is therefore quite clear that *Sphaeria acuta* Hoffm. : Fr. cannot be used as a basionym for the teleomorph *Leptosphaeria acuta*.

According to Art. 7.20 (anything associated with the sanctioning protologue) of the present ICBN, *Sphaeria acuta* Hoffm. : Fr. can be lectotypified with one of the above specimens. This does not cause problems because one and the same anamorph is concerned which was already indicated by Fuckel (1870) as *Phoma acutum* growing on *Urtica*. Fuckel introduced this binomial with the symbol "†", which he applied both for new names and for new combinations. With *Phoma acutum* † he did not give a description but referred through *Phoma complanatum* var. *acutum* Auerswald (Rabenh. Fungi europ. exs. Ser. II, No. 343. 1861, and Fungi rhenani No. 578. 1863) to *Sphaeria acuta* 'Pers.', thus also *Sphaeria acuta* sensu Fries. Fuckel's *Phoma acutum* can therefore be regarded as a new combination based on *Sphaeria acuta* Hoffm. : Fr.. Nannfeldt (1939) also regarded Fuckel's *Phoma acuta* as a new combination: *P. acuta* (Pers. ex Fr.) Fuckel. This interpretation is thus not new.

Phoma acuta (Hoffm. : Fr.) Fuckel, Symb. mycol.: 125. 1870 [as '*acutum* †'] (also documented by Fungi rhen. No. 578 in G).

basionym: *Sphaeria acuta* Hoffmann, Veget. crypt. 1: 22 [Tab. V, fig. 1, nr. 13] 1787 : Fries, Syst. mycol. 2(2): 507. 1823.

Lectotype, designated here: Sclerom. suec. Fasc. 4, No. 118 in UPS.

≡ *Aposphaeria acuta* (Hoffm. : Fr.) Berkeley, Outl. Brit. Fungol.: 315. 1860.

≡ *Leptophoma acuta* (Hoffm. : Fr.) Höhnelt, Sber. Akad. Wiss. Wien, math.-naturw. Kl., Abt. I, 124: 73. 1915. Described as anamorph of '*Leptosphaeria acuta* (Moug. et N.)', without mention of basionym of the anamorph, but with reference to Fuckel (see Höhnelt, Hedwigia 59: 262. 1917).

≡ *Plenodomus acutus* (Hoffm. : Fr.) Bubák, Annls mycol. 13: 29. 1915. Cited with basionym author Fuckel. Combination also made by Petrak, Annls mycol. 19: 192. 1921.

This species is undoubtedly identical with *Phoma hoehnelii* var. *urticae* Boerema & van Kest. apud Boerema (1976), teleom. *Lep-*

tosphaeria doliolum (Pers. : Fr.) Ces. & de Not. subsp. *doliolum*, see Boerema (1976) and Boerema *et al.* (1994).

The confusion around *Sphaeria acuta* as a basionym of the teleomorph commonly occurring on *Urtica*, *Leptosphaeria acuta*, arose by the fact that Fuckel (1870) while describing the teleomorph as *Pleospora acuta* † referred to Mougeot & Nestler No. 181, thus a duplicate of the exsiccatum mentioned by Fries. We found that the specimen of No. 181 in G also contains a (conspicuous) group of ascomata of that species, but it is unlikely that these were seen by Fries as the specimens preserved in UPS and PC do not show any ascomata. Specimens of the teleomorph were distributed by Fuckel as *Fungi rhenani* No. 900.

In view of the fact that Fuckel (1870) fully described his *Pleospora acuta* † referring to specimens without citing an author's name, we conclude that *P. acuta* is to be regarded as a new species validly described first by Fuckel. Karsten (1873) and von Höhnelt (1915), when transferring *Pleospora acuta* to *Leptosphaeria*, mistakenly regarded Mougeot & Nestler as authors of the epithet *acuta* [*Leptosphaeria acuta* '(Moug.) Karst.', and *L. acuta* '(Moug. & N.)']. Nannfeldt (1939) deliberately corrected this into '*Leptosphaeria acuta* (Fuck.) Karst.'. This author's citation was also followed by Holm (1957), Lucas & Webster (1967) and Shoemaker (1984):

Leptosphaeria acuta (Fuckel) P. Karsten, Mycol. fenn. 2: 98. 1873.
basionym: *Pleospora acuta* Fuckel, Symb. mycol.: 135. 1870. **Lectotype** *Fungi rhen.* No. 900 in G.
= *Ampullina acuta* (Fuckel) Quélet, Mém. Soc. Émul. Montbéliard, Sér. 2, No. 5: 523–524. 1875; Les Champignons du Jura et des Vosges 3: 95. 1875.

Anam. *Phoma piskorzii* (Petrak) Boerema & Loerakker, Persoonia 11: 315. 1981 [conidia significantly larger, (6–)8–10(–12) × 2–2.5

(-3) μm , than those of *Phoma acuta*, (3-)3.5-5(5.5) $\times$ 1-1.5 (-2) μm].

The nomenclature as documented here will be adopted in a monographic treatment of the *Phoma* species with *Leptosphaeria* teleomorphs (Boerema, de Gruyter & van Kesteren, 1994).

Acknowledgements

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OBERWINKLERIA, A NEW GENUS OF USTILAGINALES*

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ABSTRACT

A new genus of Ustilaginales, Tilletiaceae, Oberwinkleria K. Vánky & R. Bauer, and a new species, Oberwinkleria anulata K. & C. Vánky are described. Oberwinkleria is characterized by basidia which are reduced to the teliospores, by basidiospores produced on pedicels, by dolipores without pore caps, and a lack of haustoria or intracellular hyphae. The genus is closely related to the Tilletia - Neovossia - Conidiosporomyces group.

INTRODUCTION

Smutted specimens of Ortachne erectifolia (Gramineae) were recently collected in Venezuela. The smut fungus possesses peculiar and unique spores, and a method of spore germination which is different from all known genera (comp. Vánky, 1987).

MATERIALS AND METHODS

For studies of the soral and ultrastructural characters, freshly collected young sori of the type specimen were fixed with 2% glutaraldehyde in 0.1 M Na-cacodylate buffer at pH 7.2 for several days. After six transfers in 0.1 M Na-cacodylate buffer, the material was postfixed with 1% osmiumtetroxide in the same buffer, washed with distilled water and stained in 1% uranyl acetate for 1 hour in the dark. After 5 distilled water washes, the material was dehydrated in an acetone series, embedded in Spurr's resin, sectioned with a diamond knife. Semi-thin sections were stained with new fuchsin and crystal violet, mounted in "Entellan" and studied in a light microscope (LM). Ultra-thin sections were mounted on copper-slot-grids, post-stained with lead citrate for 5 minutes, and examined in a transmission electron microscope (TEM) at 80 kV. For scanning electron-microscopical (SEM) studies, dried spores were dusted on double-sided adhesive tape, mounted on specimen stub, sputter-coated with gold-palladium, c. 20 nm, and examined in a SEM at 10 kV.

Spore germination was obtained on water agar (WA) or on slides in water-saturated air, at room temperature, after 2 weeks.

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Fig. 1. Sori of *Oberwinkleria anulata* K. & C. Vánky in some of the ovaries scattered in the inflorescence of *Ortachne erectifolia* (type). Enlarged, a healthy seed enclosed by the lemma and palea, and a sorus, partly hidden by the lemma and palea, disarticulated from the pedicel with the two, persistent glumes.

Oberwinkleria K. Vánky & R. Bauer, gen. nov.

Sori in ovariis Graminearum, tumefacti, e membrana origine matricali fungalique, et e massa centrali sporarum pulverulentum, coloratarum, solitarium compositi. Columellae, cellulae steriles et glomeruli conidiorum absentes. Basidium evidens nullum; illud ad sporam ipsam reductum. Germinatio sporarum vel immediate basidiosporas pro ratione paucas, breves latasque in pedicellis, vel in hyphis ramosis, aseptatis efficiens. Ad hyphas, in sterigmatibus, et sporae basidiosporis similes et ballistosporae productae. Basidiosporae aut hyphis, aut ballistosporis germinantes. Typus pororum septalium: doliporus sine pileo. Hyphae parasiticae intercellulares; et hyphae intracellulares et haustoria absentes. Typus generis: Oberwinkleria anulata K. et C. Vánky.

Sori in ovaries of Gramineae, swollen, composed of a membrane of host tissue and fungal origin, and a central mass of pulverulent, pigmented, solitary spores. Columella, sterile cells and balls of conidia absent. No evident basidium; this is reduced to the spore. Spore germination results either in relatively few, short and wide basidiospores directly borne on pedicels, or in ramified, aseptate hyphae. Both basidiospore-like spores and ballistosporae are borne on sterigmata on the hyphae. Basidiospores germinate by hyphae or produce ballistosporae. Septal pore type is a dolipore without pore caps. Parasitic hyphae grow intercellularly; intracellular hyphae and haustoria absent. Typus generis: Oberwinkleria anulata K. & C. Vánky.

Oberwinkleria anulata K. & C. Vánky, sp. nov.

Typus in matrice Ortache erectifolia (Swallen) W. D. Clayton (Muhlenbergia erectifolia Swallen, Lorenzochloa erectifolia (Swallen) J. & C. Reeder; det. H. Scholz), Venezuela, Estado Mérida, ca. 50 km E. urbe Mérida, Mts. Cordillera de Mérida, Sierra Nevada, prope Laguna Mucubaj, 8°47' N, 70°47' W, alt. ca. 3580 m., 1.XII.1993, leg. R. Berndt, C. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 16003!); isotypi in BPI (802368), VEN, VIA and in Vánky, Ustilaginales exsiccata no. 914.

Sori (Fig. 1) in ovariis nonnullis, in inflorescentia dispersis, corpora ovoidea, apice acutiuscula, 0,8–1,2 x 2–3 mm, primo viridia serius atrobrunnea, pro parte a lemma et palea cooperta, plerumque simul cum illis decidua formantes. Membrana sori (Fig. 2) composita e strato externo e texto pericarpii formato, intus ad partem inferiorem sori texto tenui sporogeno fungali et sporis immaturis obducto. Columella, cellulae steriles, glomeruli conidiorum absentes. Massa sporarum nigra, pulverea, odore trimethylamineo nullo. Sporae (Fig. 3, 4) subglobosae usque ovoideae vel ellipsoideae, (8–)9–12(–13) x 9–13,5(–14,5) µm, parum fumose adumbrato-brunneae, in pariete anulo conspicuo atro, nigrescenti-brunneo, tenui (cca. 1 µm lato), secundum axem longitudinalem sporae directo; pariete cca. 1–1,5 µm crasso, dense, moderate verrucoso. Hyphae parasiticae intercellulares, haustoria absentes. Septa cum doliporo centrali sine pileo (Fig. 5). Basidium evidens nullum, ad sporam reductum. Germinatio sporarum (Fig. 8) vel immediate basidiosporas 4–6, in pedicellis 3–4 µm longis, vel in hyphis ramosis 1–2 µm crassis, aseptatis efficiens. Basidiosporae elongatae, 2,5–3 x 10–15 µm, versus apices tenuescentes, saepe parum arcuatae, ad partem 1/3–1/6 longitudinis proximalem crassiores, germinatio earum sine fusione, vel hyphas tenues (cca. 0,5 µm crassas) vel ballistosporas 2,5 x 7–8 µm efficiens. Ad hyphas, ad sterigmata et sporae basidiosporis similes et ballistosporae provenientes. Sporae basidiosporis similes in hyphis provenientes aut mono- aut bicellulares.

Sori (Fig. 1) in some of the ovaries, scattered in the inflorescence, forming ovoid bodies with an acute tip, 0.8–1.2 x 2–3 mm, first green later dark brown, usually falling from the host together with, and partly enclosed by, the lemma and palea. The sorus membrane (Fig. 2) is composed of an outer layer of pericarp tissue lined on the proximal part of the sorus by a thin, sporogenous fungal tissue and immature spores. Columella, sterile cells and balls of conidia absent. Spore mass black, powdery, lacking smell of trimethylamine. Spores (Figs. 3, 4) subglobose to ovoid or ellipsoidal, (8–)9–12(–13) x 9–13.5(–14.5) μm , light, smokey-tinted brown, with an evident, dark blackish-brown, narrow (c. 1 μm wide) ring of the wall, running in direction of the longitudinal axis; wall 1–1.5 μm thick, densely, moderately coarsely verrucose. The parasitic hyphae are intercellular, lacking haustoria. The septa have a central dolipore without pore caps (Fig. 5). No evident basidium; this is reduced to the spore. Spore germination (Fig. 8) results either in 4–6 basidiospores directly produced on 3–4 μm long pedicels, or in ramified, 1–2 μm thick, aseptate hyphae. The basidiospores are elongate, 2.5–3 x 10–19 μm , tapering toward each end, often slightly bent, thickest at the proximal 1/3–1/6 part. They germinate without fusion, giving rise to thin (c. 0.5 μm), aseptate, ramified hyphae, or to ballistospores measuring 2.5 x 7–8 μm . Both basidiospore-like spores and ballistospores are borne on sterigmata on the hyphae. The basidiospore-like spores produced on hyphae may be one- or two-celled.

The young spores are hyaline, globose or lacrimiform, usually with a shorter or longer, narrow appendage, the remainder of the sporogenous hypha. The inconspicuous, hyaline appendage may be present on some of the mature spores. With maturation, the spores increase in size, become more or less subpolyhedral by mutual pressure, and finely verruculose. Nearly mature spores have the size and form of the mature ones, are slightly pigmented but still no darker ring is visible in the spore wall. The ring only appears in the fully mature and pigmented spores, caused by deposition of dark-coloured substance in the external layers of the endospore. (Figs. 6, 7).

The spores of *O. anulata* did not germinate on malt-yeast-peptone-agar (MYP); on WA they germinated exclusively by hyphae. Germination mainly with basidiospores was obtained on slides in water-saturated air, without any nutrient substance.

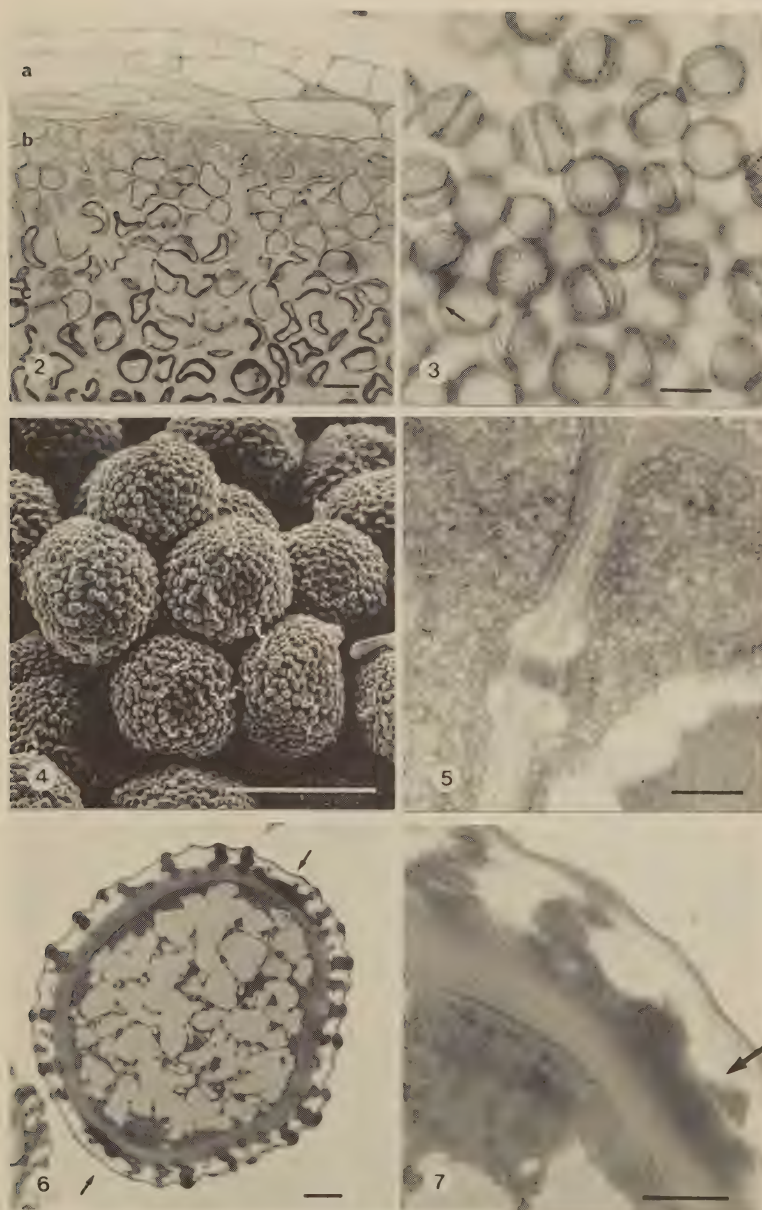
Fig. 2. Part of a transvers section about at the center of a sorus of *Oberwinkleria anulata* with the external layer of host tissue (a), internal layer of sporogenous fungal tissue and young, immature spores (b), and nearly mature spores toward the middle of the sorus (c). (Bar = 10 μm).

Figs. 3, 4. Spores of *Oberwinkleria anulata* in LM and SEM (type). In LM pictures the dark, narrow ring of the spores, typical for this species is evident, and in some spores also a short, narrow, hyaline appendage (arrows) is visible. The ring of the spores cannot be traced in SEM pictures. (Bars = 10 μm).

Fig. 5. Dolipore of *Oberwinkleria anulata* lacking pore caps (TEM; Bar = 0.1 μm).

Fig. 6. A sectioned spore of *Oberwinkleria anulata* with the two dark areas (arrows) on opposite sides of the spore, corresponding to the ring. The verrucae show the same dark structure as the ring (TEM). (Bar = 1 μm).

Fig. 7. Spore wall structure of *Oberwinkleria anulata* including the dark area of the ring (arrow; TEM). (Bar = 0.5 μm).



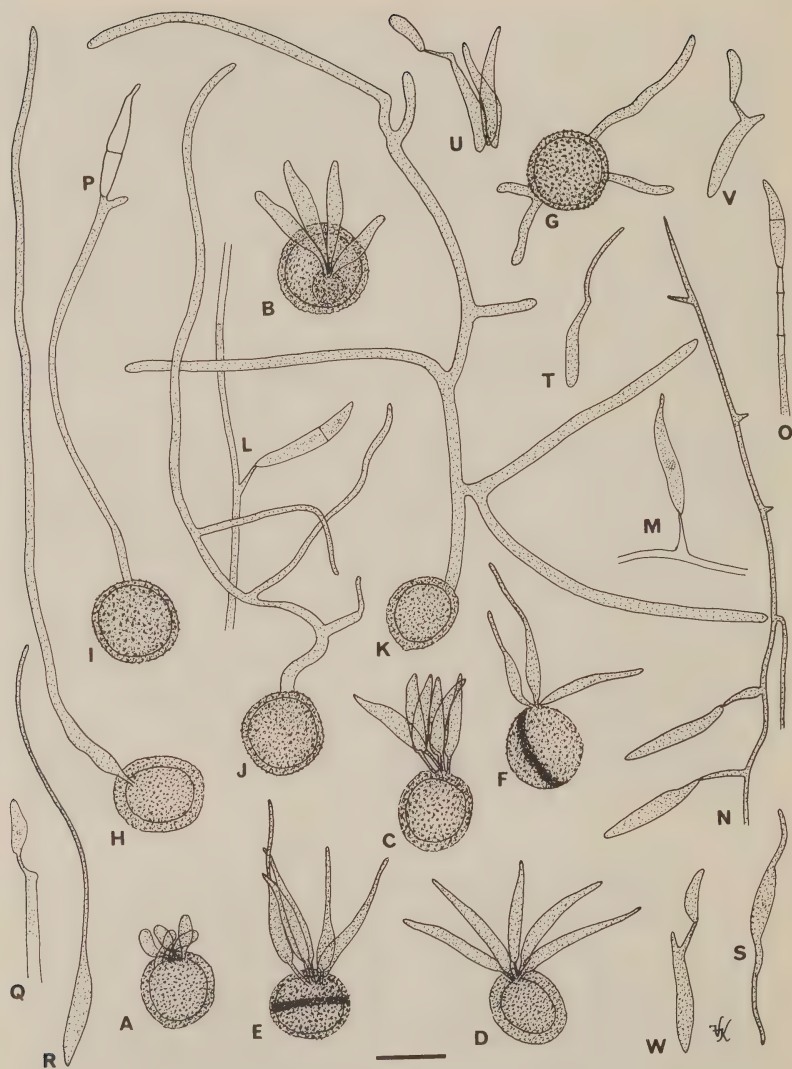


Fig. 8. Spore germination of *Oberwinkleria anulata* (type) results either in basidiospores borne on pedicels (A, B, C, D, E, F) or in aseptate, often ramified hyphae (G, H, I, J, K) on which both basidiospore-like spores (L, M, N, O, P) and ballistospores (Q) are borne. Germination of basidiospores results either in narrow, aseptate hyphae (E, F, R, S, T) or in ballistospores (U, V, W).
Bar = 10 μ m.

DISCUSSION

Oberwinkleria anulata has dolipore septa without pore caps, in common with species of *Tilletia* (*T. caries*, *T. indica*; Roberson & Luttrell, 1989), *Neovossia* (*N. molinae*; Bauer, unpublished data), *Conidiosporomyces* (*C. ayresii*; Vánky & Bauer, 1992:430, Fig. 8) and *Entorrhiza* (*E. casparyana*; Deml & Oberwinkler, 1981:393 & Fig. 10). Unlike *Entorrhiza* (Fineran, 1980, Figs. 6-10; Deml & Oberwinkler, 1981:393 & Fig. 11), the intercellular hyphae of *O. anulata* do not penetrate in the host cells. Likewise, the hyphae are intercellular in *Tilletia* (Luttrell, 1987:2582, 'found "almost entirely" intercellular hyphae in *T. caries*, while Bauer, unpublished data, found exclusively intercellular hyphae), *Neovossia* (Bauer, unpublished) and *Conidiosporomyces* (Vánky & Bauer, 1992:430, Fig. 4).

Thus, the ultrastructural characteristics indicate a close relationship of *O. anulata* with the *Tilletia* - *Neovossia* - *Conidiosporomyces* group but not with *Entorrhiza*, which also has a unique type of spore germination (Fineran, 1982). In species of *Tilletia*, *Neovossia* and *Conidiosporomyces*, however, well-developed holobasidia are present. They may vary in length from species to species and from basidium to basidium, but they are never reduced to the teliospore itself, as in *Oberwinkleria*. Thus, the teliospores of *O. anulata* have, beside the function of propagation and resistance, the function of basidia at the time of spore germination. This feature is unique among the *Tilletiaceae*. The type of spore germination of *O. anulata*, like that of many other species of *Ustilaginales* and other *Basidiomycetes*, can be influenced by environmental factors but, in optimal conditions, in species of *Tilletiaceae*, development of basidiospores will appear. Unlike *Tilletia*, *Neovossia* and *Conidiosporomyces*, the basidiospores of *Oberwinkleria anulata* are produced on relatively long pedicels (sterigmata?).

Based on the soral, ultrastructural and germination characters, *O. anulata* belongs to the *Tilletiaceae* family, and stands closest to the *Tilletia* - *Neovossia* complex.

The narrow, well-delimited, dark ring of the spores is unique and typical for *Oberwinkleria anulata*. In *Planetella lironis* Savile a wide, dark brown, equatorial band is present due to the two, thin-walled, pale yellowish-brown "polar" areas of the spores. In other aspects, the monotypic *Planetella* is very close to *Anthracoidea*. In some typical *Ustilago* species, e. g., *U. bullata* Berkeley, or *U. turcomanica* Tranzschel ex K. Vánky, the spores may possess slightly lighter polar areas and consequently a somewhat darker, wide equatorial band, which cannot be compared with the ring of *O. anulata*.

The small number, the shape and the size of the basidiospores are also typical for this species. The number of basidiospores in *Tilletia caries* (DC.) L.-R. & C. Tul., the type species of the genus, is 8-16, they are more elongated, measuring 2.5-3.5 x 50-100 µm and germinate after fusion. In *Neovossia molinae* (Thümen) Körnicke, the type of *Neovossia*, many, long, acicular basidiospores are produced which germinate without fusion. In *Conidiosporomyces ayresii* (Berk.) K. Vánky 10-24 basidiospores are produced measuring 2 x 30-36 µm. These germinate without conjugation (Vánky & Bauer, 1992:429-431).

No *Ustilaginales* have been previously reported on *Ortachne* or *Lorenzochloa*. On *Muhlenbergia* nine *Tilletia* species are known: 1. *T. asperifolia* Ellis & Everhart, 1887:55 (type on *Sporobolus asperifolius* = *M. asperifolia*, USA), 2. *T. asperifolioides* G. W. Fischer, 1952:6 (type on *M. filiformis*, USA), 3. *T. eremophila* Spegazzini, 1909:291 (type on *Sporobolus asperifolius* = *M. asperifolia*, Argentina), 4. *T. macrotuberculata* Durán, 1987:156 (type on *M. pulcherrima* = *M. peruviana*, Mexico), 5. *T. montana* Ellis & Everhart, 1887:55 (type on *Sporobolus gracillimus* = *M. filiformis*, USA), 6. *T. muhlenbergiae* G. P. Clinton, 1906:49 (type on *M. schaffneri* var. *elongata*, Mexico), 7. *T. pachyderma* G. W. Fischer, 1952:7 (type on *M. utilis*, Mexico), 8. *T. tuberculata* Durán, 1987:164 (type on *M. depauperata*, Mexico), and 9. *T. zonata* Brefeld, 1895:161

(type on Sporobolus ligularis = M. ligularis, Ecuador). Several of these species possess characters of Neovossia, a genus closely related to, and not satisfactorily delimited from Tilletia (comp. Vánky & Bauer, 1992:434). According to Durán & Fischer (1961:31), T. eremophila is identical with T. asperifolia. Oberwinkleria anulata is different from all these species.

This basidiomycete genus, with basidia reduced to the teliospores, is named in honour of the excellent German phanerogamist, mycologist and basidiomycete specialist, Professor Dr. Franz Oberwinkler.

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**ERYNIA CHIRONOMIS, COMB. NOV.
(ZYGOMYCETES: ENTOMOPHTHORALES)**

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The text of a recent article describing two new entomophthoralean pathogens of dipterans in China (Fan & Li, 1994) incorrectly referred to one of these new species as *Pandora chironomis* Fan & Li at the point of its formal description. This fungus is a species of the genus *Erynia* (Nowakowski ex Batko) Remaudière & Hennebert (sensu Humber, 1989) and was referred to as such in all other parts of the manuscript.

In order to correct this error, we hereby propose the following new combination:

***Erynia chironomis* (Fan & Li) Fan & Li, comb. nov.**

Basionym: *Pandora chironomis* Fan & Li, 1994,
Mycotaxon 50: 310.

LITERATURE CITED

- Fan, M. and Z. Li. 1994. Two new pathogens of dipteran insects. *Mycotaxon* 50: 307-314.
Humber, R.A. 1989. Synopsis of a revised classification for the Entomophthorales (Zygomycotina). *Mycotaxon* 34: 441-460.

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A TAXONOMIC STUDY ON FUNGI ASSOCIATED WITH SPRUCE BUD BLIGHT IN CHINA

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SUMMARY

Fungi associated with bud blight of *Picea schrenkiana* in Xinjiang, China were surveyed. Four species were found associated with the disease, *Gemmamyces piceae* and its anamorph *Megaloseptoria mirabilis*, a newly proposed species, *Gemmamyces piceicola* and *Dichomera gemmicola*. The main characteristics of these four fungi are given in a summary table.

The spruce bud blight commonly occurring on various species of *Picea* in many countries of North Europe is caused by *Gemmamyces piceae* (Borthwick) Casagrande or *Cucurbitaria piceae* Borthwick (Borthwick, 1909; Spaulding, 1961; Shoemaker, 1967; Casagrande, 1969; Sivanesan, 1984; Smith et al., 1988). Two coelomycetous fungi, *Megaloseptoria mirabilis* Naumov and *Camarosporium strobilinum* Bomm., Rouss. & Sacc., were found associated with this disease, but only *Megaloseptoria mirabilis* is the anamorph of *G. piceae* (Casagrande, 1969; Sivanesan, 1984). In Canada, bud blight of *Picea* spp. is recorded as *C. strobilinum* and another coelomycetous species, *Dichomera gemmicola* Funk & Sutton (Funk & Sutton, 1972; Funk, 1981). This disease has been also recorded on buds of Schrenk spruce (*Picea schrenkiana* Fisch. et Mey.) from Xinjiang region (province) of China (Anon., 1982, 1988). Recently, however, other different fungi were noted being associated with the spruce bud blight. A taxonomic study of the specimen preserved in the Herbarium of Mycology, August 1st Agricultural College (HMAAC) and freshly collected on buds of Schrenk spruce from Tianshan Mountain (TM), Urumqi was undertaken in an attempt to survey the blight causal agents in Xinjiang. The examination showed there were four species, *M. mirabilis* and its teleomorph *G. piceae*, *D. gemmicola* and an unusual *Gemmamyces* species, associated with the spruce bud blight occurring in Xinjiang. All the known species are presented here and the unusual one is described as a new species of *Gemmamyces*.

All specimen treated in the paper are deposited in the HMAAC, Urumqi, Xinjiang, P.R. China, except for the new species, the holotype of which is deposited in the National Herbarium of Canada in Ottawa (DAOM).

DESCRIPTION

Gemmamyces piceae (Borthwick) Casagrande, Phytopathol. Z. 66: 119, 1969. Fig. 1.a

Syn: *Cucurbitaria piceae* Borthwick, Notes Royal Bot. Gard. Edinburgh 4(20): 261, 1909.

Megalospora gemmicida Naumov, Mat. Mycol. Phytopathol. Jacz. 6: 9, 1927.

Ascomata superficial, separate to gregarious in groups or on a basal stroma, black, spherical, 250-550 μm diam.; peridium 50-80 μm wide, composed of brown to dark brown thick-walled, angular to sub-rounded cells in outer layers and of hyaline to brownish thin-walled angular to elongated cells. Asci 200 x 25 μm , 8-spored, clavate-cylindrical. Pseudoparaphyses cellular, septate. Ascospores 40-50 x 12-14 μm , uniseriate, pale to mid brown, fusiform, with 5-8 transverse septa and one or more longitudinal septa in each cell, except the end cell, constricted at the median septum; wall smooth.

Anamorph: *Megaloseptoria mirabilis* Naumov, Bolezni Rastenii 14: 144, 1925. Fig. 1.b

Conidiomata superficial, gregarious in groups or on a basal stroma, dark brown, spheroid, 300-560 μm diam, apex papillate, wall of conidioma 30-40 μm wide. Conidiophores hyaline, simple, conidiogenous cells enteroblastic. Conidia hyaline, scoleoid, erect or curved, base truncate and apex narrower, rounded, with 8-29 transverse septa, 105-180 x 5-6 μm .

On buds of *Picea schrenkiana* Fisch. et Mey.

Specimen examined, -Xinjiang: TM, Urumqi, 24 V 1981, Z.Y. Zhao et al. 810255, HMAAC 43; VII 1983, Z.Y. Zhao et al. 830109, HMAAC 817; VII 1990, Z.Q. Yuan, HMAAC 810; VII 1992, Z.Q. Yuan, HMAAC 812 & 813.

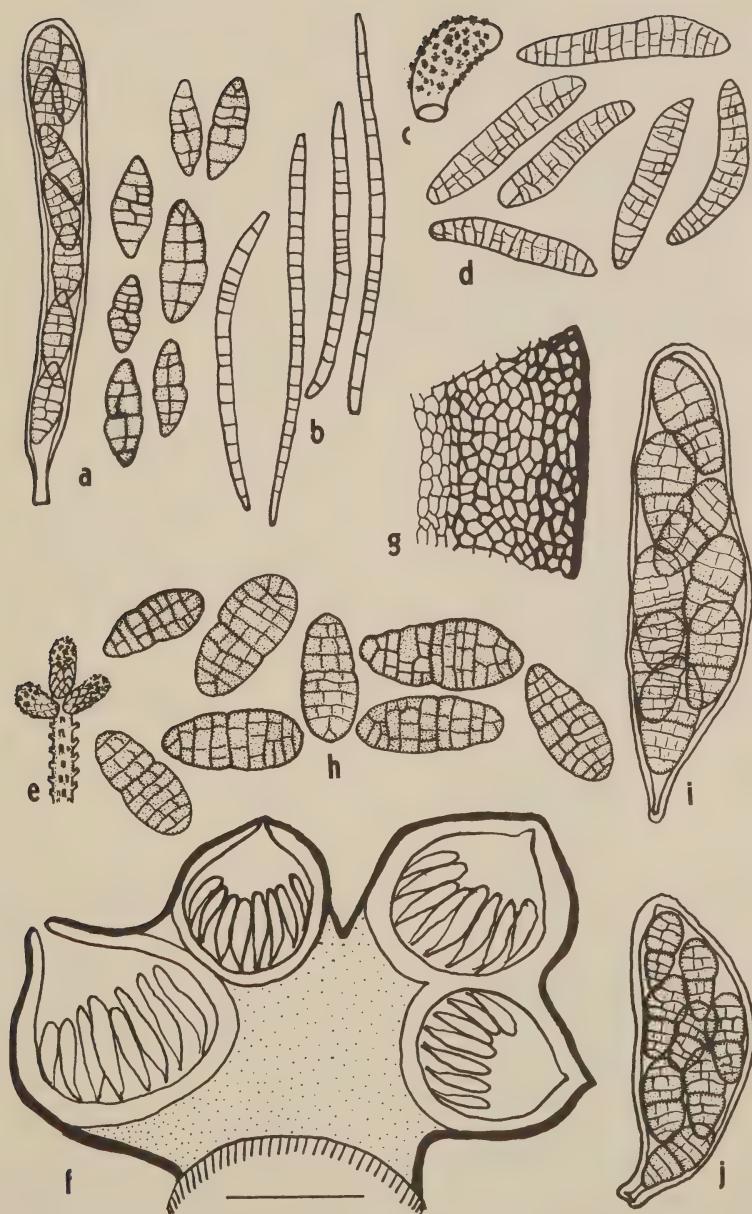
Dichomera gemmicola Funk & Sutton, Canad. J. Bot. 50: 1514, 1972. Fig. 1.c,d

Conidiomata erumpent to superficial, caespitose on a basal stroma or diffusely gregarious, dark brown to black, surface roughened, spheroid, 370-570 μm diam, apex papillate; wall of conidiomata 40 μm wide, composed of dark brown pseudoparenchymatous cells in outer layers and of hyaline, thin-walled cells. Conidiogenous cells with one annellation, 6.5-11.5 x 5-7.5 μm . Conidia hyaline to pale brown, cylindrical or worm-shaped, with truncate or rounded base and narrower apex. muriform, with 14-19 transverse septa and several longitudinal septa, 68-96 x 13-16 μm .

On buds of *Picea schrenkiana* Fisch. et Mey.

Specimen examined, -Xinjiang: TM, Urumqi, VII 1983, Z.Y. Zhao et al. 830109, HMAAC 815; VII 1992, Z.Q. Yuan, HMAAC 814.

Fig.1. a. *Gemmamyces piceae*: ascus & ascospores; b. *Megaloseptoria mirabilis*: conidia; c,d. *Dichomera gemmicola*: c. habit, d. conidia; e-j. *Gemmamyces piceicola*: e. habit, f. ascomata in vertical sections, g. detail of peridium, h. ascospores, i. ascus (holotype), j. ascus (HMAAC 816). Standard line = 200 μm for f, 50 μm for a, b, d, g-j. Habits (c & e) about natural size.



***Gemmamyces piceicola* Z.Q. Yuan sp. nov. Fig.1.e-j**

Ascomata erumpentia ad superficialia, catervatim caespitosa, fusca vel nigra; superficie rugulosa, sphaerica vel sphaeroidea, 240-450 μm lata, 300-400 μm alta, apice papillata; peridia 40-75 (-90) μm lata, friabilia, e cellulis pseudoparenchymatii fuscis crassitunicatis, polygonis ad rotundatis in stratis externis et e cellulis elongatis tenuitunicatis hyalinis in stratis internis composita. Asci (125-) 140-210 x 40-50 μm , octospori, clavati ad ovoidei, stipitati. Pseudoparaphyses inaequales, cellulosa. Ascosporae 35-68 x 18-26 μm , biseriatae vel multiseriatae, subfulvae, obovatae cum extremo obtuso vel rotundato, muriformes, 7-11-transverse septatae, 1-plures longitudinaliter septatae, constrictae ad septa formata initio, asymmetricae; partione superior latius quam partione inferior; exosporio glabro.

In gemmis *Piceae schrenkianae* Fisch. et Mey., Monte Tianshanico, Urumqi, Provincia Xinjiangensi, Sinicarum, 2 VII 1992, Z.Q. Yuan 92006 DAOM holotypus. Isotypi in HMAAC (HMAAC 811) depositi.

Ascomata erumpent to superficial, caespitose in groups on a common basal compact stroma, dark brown to black, surface roughened, spherical or spheroid, 240-450 μm wide, 300-400 μm high; apex minute papillate; peridium 40-75 (-90) μm wide, crisp, especially at base, composed of dark brown, thick-walled, angular to rounded pseudoparenchymatous cells in outer layers and of hyaline, thin-walled elongated cells in the inner layers. Asci (125-) 140-210 x 40-50 μm , 8-spored, clavate to ovoid, short stalked. Pseudoparaphyses collapsed, irregular, cellular. Ascospores 35-68 x 18-26 (mean 51.2 x 22.9) μm , yellowish brown, obovoid, ends obtuse to rounded, asymmetric, upper part wider and longer than lower part, the lower part of some ascospores conic but ends obtuse, 7-11-septate, most cells with 1-several longitudinal septa, constricted at the first-formed median septum; walls smooth.

On buds of *Picea schrenkiana* Fisch. et Mey., Tianshan Mountain, Urumqi, Xinjiang, 2 VII 1992, Z.Q. Yuan 92006 DAOM holotype, HMAAC 811 isotype.

Additional specimen examined, -Xinjiang; TM, Urumqi, VII 1983, Z.Y. Zhao et al. 830109, HMAAC 816; 1 VII 1992, Z.Q. Yuan 92004, HMAAC 809; 5 VII 1993, P. Jiang, HMAAC 818.

DISCUSSION

Four species were found associated with the spruce bud blight occurring in Xinjiang, China. Among them only *M. mirabilis* was previously recorded in China. The others are new to China. The characteristics of these four species on *Picea* spp. are compared in Table 1. The name *Gemmamyces piceae* (Borthwick) Casagrande is commonly used in Europe for the disease (Sivanesan, 1984; Cannon et al., 1985; Smith et al., 1988), but the monotypic genus *Gemmamyces* was not accepted extensively. Petrak (1970) treated it as a synonym of *Cucurbitodhis*. Eriksson & Hawksworth (1987) included it in *Cucurbitaria*. Barr (1990) considered that *G. piceae* seemed not be generically different from *Cucurbitaria*, but she now accepts *Gemmamyces* as a genus separate from *Cucurbitaria* on the basis of study of the present new species and a careful re-examination of the literature (Barr, 1994, personal communication). She added some different features between *Cucurbitaria* and *Gemmamyces*: the former is hemibiotrophic on woody dicotyledonous plants and the latter is biotrophic on conifer buds; the peridium of ascomata in *Gemmamyces* is much less dense, softer to section than that in

Table 1: The main features of four fungi on buds of *Picea* spp.

Teleomorphs	Species	<i>G. piceae</i>	<i>G. piceicola</i>
	Hosts	<i>P. abies</i> , <i>P. glauca</i> , <i>P. pungens</i> var. <i>glauca</i> , <i>P. pungens</i> var. <i>coerulea</i> , <i>P. schrenkiana</i>	<i>P. schrenkiana</i>
	Ascomata	cespitose in groups, spherical, 300–600 μm diam.	cespitose in groups on a common basal stroma, sphaeroid, 240–450 μm wide, 300–400 μm high
	Peridium	35–70 μm wide ¹ , of dark brown thick-walled cells in outer layers and hyaline, thin-walled cells in inner layers	40–75(–90) μm wide, of dark brown, thick-walled angular to rounded pseudoparan chymatous cells in outer layers and hyaline to brownish thin-walled cells in inner layers.
	Ascus	clavate-cylindrical, 180–250 x 25–30 μm ¹	clavate to ovoid, (125–)140–210 x 40–50 μm
	Asco-spore	uni-seriate, 35–50x13–15 μm ¹ , 40–50 x 13–19 μm ² , fusiform, 5–8-septate, constricted at the first-formed septum, symmetric.	biseriate to multiseriate, 38–68x18–26 (mean 51.2x22.9) μm . obovate, 7–11-septate, constricted at first-formed septum, asymmetric, upper part wider than lower part.
Anamorphs	species	<i>M. mirabilis</i>	<i>D. gemmicola</i>
	Hosts	<i>P. schrenkiana</i> ⁵ , other as in <i>G. piceae</i>	<i>P. glauca</i> , <i>P. engelmannii</i> , <i>P. sitchensis</i> ⁴ , <i>P. schrenkiana</i> ⁵ .
	Conid- iomata	gregarious, 400–600 μm diam ¹ ; 300–560 μm ⁵	diffuse, 350 μm diam, 450 μm high ¹ ; 370–570 μm diam ⁵
	Conidia	scolecoid, 220–315x5–7 μm ¹ , 150–200x5–9 μm ³ , 100–180x5–6 μm ⁵ .	long fusiform, 70–85x12–17 μm ¹ ; 68–96x13–16 μm ⁵ .
	Septum	31–46-septate ¹ ; 7–21-septate ³ ; 8–29-septate ⁵	11–17-transverse septate and 1–several longitudinal septate ⁵ ; 14–19 transverse septa

1. based on Shoemaker, 1967; 2. on Ellis & Ellis, 1982; 3. on Sivanesan, 1984; 4. on Funk & Sutton, 1972; 5. on present authors.

Cucurbitaria species, and also ascospores are larger and rather lightly pigmented. Accordingly we take *Gemmamyces* as the correct name. Our collections agree well in morphology of both the teleomorph and anamorph with *G. piceae*.

Dichomera gemmicola causes bud necrosis of *Picea* spp. and *Pseudotsuga* in Canada (Funk, 1981). Our fungus fits well in habit and morphology with it.

Gemmamyces piceicola is close to *G. piceae* in habitat and pathogenicity. They differ in ascospore shape, size, number of septa and in ascus shape. In addition, the fungus always develops on small buds (Fig.1.e) while the other three species form on large buds, as in *D. gemmicola* (Fig.1.c) We have not seen the anamorph of the new ascomycetous species, but there might be some correlation between *G. piceicola* and *D. gemmicola*, as we collected them in the same locations. This needs proving in the future.

The authors are much obliged to Dr. M. E. Barr (Sidney, B. C., Canada) for kind advice on the disposition of the new species, and for reviewing the manuscript.

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WOOD-DECAY BASIDIOMYCETES FROM THE STATE OF BOLIVAR IN SOUTHEASTERN VENEZUELA

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SUMMARY

This report summarizes information on wood-decay fungi from the Lote Boscoso San Pedro in the state of Bolívar in southeastern Venezuela. Forty-four species are reported, including 12 new to the Venezuelan rainforest: *Lentinus scleropus*, *Megasporoporia setulosa*, *Postia floriformis*, *Phellinus durissimus*, *P. pectinatus*, *P. rhababarinus*, *P. robustus*, *Pleurotus flavolanatus*, *P. ostreatus*, *Trametes cervina*, *Tyromyces hydrophilus*, and *Rigidoporus umbonatipes*. Information is presented on substrate/host relationships, type of rot produced, and geographic distribution for each species.

RESUMEN

Este reporte se sumaria información acerca de hongos descomponedores de madera del Lote Boscoso, San Pedro en el Estado Bolívar, ubicado al sur-este de Venezuela. Se reportan cuarenta y cuatro especies, incluyendo 12 nuevas del bosque tropical Venezolano: *Lentinus scleropus*, *Megasporoporia setulosa*, *Postia floriformis*, *Phellinus durissimus*, *P. pectinatus*, *P. rhababarinus*, *P. robustus*, *Pleurotus flavolanatus*, *P. ostreatus*, *Trametes cervina*, *Tyromyces hydrophilus*, y *Rigidoporus umbonatipes*. Se presenta información en relación a la interacción sustrato/hospedero, tipo de pudrición producida y la distribución geográfica de cada especie.

INTRODUCTION

The Lote Boscoso San Pedro is located in the Piar and Rocio districts of Bolívar State, 7°00'30" N and 62°29'30" W, in southeastern Venezuela. The area covers about 750,000 ha and ranges from tropical dry forest to premontane rain forest. The vegetation is very dense with a few widely scattered savannas, thickets, and open forests. The important tree species are *Mora gonggripii* (Kleinh.) Sandw. (mora), *Cordia alliodora* (R. & P.) Cham. (pardillo), *Hymenaea courbaril* L. (algarrobo), *Peltogyne porphyrocardia* Griesb. (zapatero), *Piranhea longepedunculata* Jablonsky (caramacate), and *Erisma uncinatum* Warm. (mureillo) (Rodríguez, 1992).

Venezuelan Polyporaceae have been described in the literature (Patouillard & Gaillard, 1888; Patouillard, 1889a,b, 1891, 1927; Sydow, 1930; Overholts, 1934; Chardon & Toro, 1934; Wolf, 1949; Dennis, 1965; Fidalgo & Fidalgo, 1967, 1968; Fidalgo, 1968a; Dennis, 1970; Holmquist, 1972; Setliff, 1984; Rogerson *et al.*, 1990).

DESCRIPTION OF SPECIES

Forty-four wood-decay species were collected from October 1989 to November 1991; 12 of these are new to Venezuela. A host/substrate index for the Venezuelan collections is shown in Table 1. The taxa are members of the Polyporaceae, Hymenochaetaceae, and Thelephoraceae. Species are listed in alphabetical order; those preceded by an asterisk (*) are new records for Venezuela. All collections have voucher specimens deposited at the Center for Forest Mycology Research (CFMR). Those collections preceded by two asterisks (**) have cultures deposited at the CFMR. The first statement under substrate or distribution was derived from data from our study. The remaining information on distribution and substrate preferences from South and Central America was obtained from other authors.

Antrodia albida (Fr.) Donk., Persoonia 4: 339, 1966.

SPECIMEN NUMBER: **CR-20.

TYPE OF ROT: Brown rot.

SUBSTRATE: On trunks of *Diplotropis purpurea* (Rich.) Amsch. (congrio); on various hardwoods; more rarely on gymnosperms; common on dead branches of *Juniperus* sp., but present on posts and structural wood (Murrill, 1915; Overholts, 1953; Gilbertson & Ryvarden, 1986); on railroad sleepers (Cunningham, 1965); common on Eleocarpaceae, Myrsinaceae, Oleaceae, Pinaceae, Pittosporaceae, Rosaceae, Rubiaceae, and Strophulariaceae (Cunningham, 1965); on *Eucalyptus* sp. in Brazil (Rick, 1960); on dead liana (Fidalgo, 1968).

DISTRIBUTION: Common in Venezuela. Widespread, reported as a resupinate fungus near *Trametes sepium* (Dennis, 1970).

Auricularia polytricha (Mont.) Sacc., Att. Ist. Vaneto. Sci. 3: 722, 1885.

SPECIMEN NUMBER: **CR-03, **CR-70.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of congrio; common on dead hardwood.

DISTRIBUTION: Common in Venezuela on dead and rotting hardwood. Widely collected in Venezuela in Amazonas and Bolivar state (Rogerson *et al.*, 1990). Common in tropical America (Duncan, 1972; Lowy, 1952). Common in the tropical areas (Fidalgo, 1968).

Corioloopsis caperata (Berk.) Murr., N. Amer. Fl. 9(2): 77, 1908.

SPECIMEN NUMBER: CR-113, **CR-77, **CR-56.

TYPE OF ROT: White rot.

SUBSTRATE: On branches of unidentified hardwood; on angiosperms of all kinds (Ryvarden & Johansen, 1980).

DISTRIBUTION: Widespread in Venezuela. In San Fernando de Apure, el Limon, and Carabobo, Táchira, Yaracuy, and Miranda states (Fidalgo, 1968). In Amazonas, Bolivar and Monagas states (Rogerson *et al.*, 1990). *C. caperata*, known from tropical regions, is particularly common in South America, Central America, and West Indies (Fidalgo & Fidalgo, 1968). Widespread in tropical America (Ryvarden & Johansen, 1980).

Cyclomyces iodinus (Mont.) Pat., Essai Taxon. Hymenom. p. 98, 1900.

SPECIMEN NUMBER: **CR-100, **CR-1, **CR-7.

TYPE OF ROT: White rot.

SUBSTRATE: On branches of dead hardwood; on rotting dead hardwood (Saccardo, 1888; Murrill 1915); common on bark and branches on the ground (Overholts 1953).

DISTRIBUTION: Common in Venezuela. Bolivar state (Rogerson *et al.*, 1990).

Venezuela and Cuba (Saccardo, 1888). Trinidad, Venezuela, and Ecuador as *Polyporus iodinus* (Dennis, 1970). Tropical species (Overholts, 1953; Cunningham, 1965).

Dacryopinax indacocheae Lowy, Mycologia 51: 848, 1959.

SPECIMEN NUMBER: **CR-72.

TYPE OF ROT: Brown rot.

SUBSTRATE: On unidentified branch on soil.

DISTRIBUTION: In Bolivar State (Rogerson *et al.*, 1990). In Bolivia and Brazil (Lowy, 1971).

Dacryopinax spathularia (Schw.) Martin, Lloydia 11: 116, 1948.

SPECIMEN NUMBER: **CR-54.

TYPE OF ROT: Brown rot.

SUBSTRATE: On unidentified branches; on gymnosperm and angiosperm wood (McNabb, 1965); branches of different species of hardwood (Dennis, 1970; Saccardo, 1888).

DISTRIBUTION: In Miranda state (Chardon & Toro, 1934). Venezuela, Trinidad, British Guiana, Colombia, and Panama (Dennis, 1970). Widely collected in Amazonas and Bolivar state (Rogerson *et al.*, 1990). Cuba, Central America, Brazil, India, and Ceylon (Saccardo, 1888). South America (Farr *et al.*, 1989).

Earliella scabrosa (Pers.) Gilbn. & Ryv., Mycotaxon 22: 364, 1985.

SPECIMEN NUMBER: **CR-85, **CR-68, **CR-80, **CR-46, **CR-95, **CR-45, **CR-103.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of *Jacaranda capia* D. Don. (simaruba) and logs of algarrobo; common on dead hardwood; on *Terminalia obovata* Eichl., *Hernandia sonora* Linn., *Persea americana* P. miller., *Artocarpus communis* Frost., *Sterculia caribaea* R. Br., and *Theobroma cacao* L. (Fidalgo & Fidalgo, 1968).

DISTRIBUTION: In Carabobo state (Chardon & Toro, 1934). Aragua state (Wolf, 1949); Miranda state (Dennis, 1970), and Barinas state (Holmquist, 1972). Widely collected as *Earliella corrugata* in Bolivar and Amazonas states (Rogerson *et al.*, 1990). Known in tropical regions worldwide (Fidalgo & Fidalgo, 1968). Pantropical (Ryvarden & Johansen, 1980).

Fomitopsis feei (Fr.) Kreisel, Univ. Habana. ser. 4, Cienc. Biol. 16: 83, 1971.

SPECIMEN NUMBER: **CR-76, **CR-86.

TYPE OF ROT: Associated with brown cubical rot of dead hardwood.

SUBSTRATE: On branch of unidentified hardwood; on *Piptadenia rigida* Benth., *Lonchocarpus* sp., *Acacia melanoxylon* R. Br., *Eucalyptus gumifera* (Gaertner) Hochr., (Carranza-Morse & Gilbertson, 1986).

DISTRIBUTION: In Venezuela, Calabozo and Orituce River; North, Central, and South America; Caribbean Islands (Carranza-Morse & Gilbertson, 1986).

Gloeophyllum striatum (Sw.:Fr.) Murr., Bull. Torrey Bot. Club. 32: 370, 1905.

SPECIMEN NUMBER: **CR-04, **CR-126.

TYPE OF ROT: Brown rot.

SUBSTRATE: On trunk of dead congrio and branches of *Pinus caribaea* var. *hondurensis* Horelet; common on dead conifers and hardwoods (Overholts, 1953).

DISTRIBUTION: Common in Venezuela; American tropics (Fidalgo, 1968).

Hexagonia hydnoides (Fr.:Sw.) Fidalgo, M., Mem. New York Bot. Gard. 17 (2): 35, 1968.

SPECIMEN NUMBER: **CR-22.

TYPE OF ROT: White rot.

SUBSTRATE: On dead wood such as dead branches of living trees, old stumps, railway ties, fenceposts (Fidalgo, 1968b); on treated and untreated wood (Carranza-Morse, 1992); on dead wood of *Acacia* sp. (Patouillard & Hein, 1928).

DISTRIBUTION: Widespread in Venezuela. Amazonas and Bolivar, Gúarico, Miranda, Monagas, and Sucre states (Fidalgo, 1968). Widespread in Amazonas and Bolivar state (Rogerson *et al.*, 1990). Common in American tropics, Central America, West Indies, and South America (Fidalgo, 1968). Semidry areas and savannas (Gilbertson & Ryvarden, 1986). COMMENTS: *Hexagona hydnoides* is sometimes a pathogen, on living *Ficus retusa* L. in Brazil and on *Tamarindus indica* L. in Virgin Islands (Fidalgo, 1968).

Hymenochaete luteo-badia (Fr.) V. Höhn. & Litsch., K., Akad. Wiss. Wein Sitzungs. Ber. 116: 754, 1907.

SPECIMEN NUMBER: **CR-29.

TYPE OF ROT: Brown rot.

SUBSTRATE: On unidentified hardwood branches; common on decomposing or rotting dead hardwood (Burt, 1966).

DISTRIBUTION: Trinidad, British Guiana, and Venezuela (Dennis, 1970). Amazonas and Bolivar states (Rogerson *et al.*, 1990). Venezuela, Dutch Guiana, and Trinidad (Burt, 1918). Guadalupe, Puerto Rico, British Honduras, and British Guiana (Fidalgo, 1968). Galapagos Islands, Ecuador (Reid *et al.*, 1981).

* *Lentinus scleropus* (Pers.) Fr., Syn. Gen. Lent. 10, 1836.

SPECIMEN NUMBER: **CR-113.

TYPE OF ROT: Brown rot.

SUBSTRATE: On log of algarrobo.

DISTRIBUTION: In Mexico, Nicaragua, Cuba, Dominica, Brazil and Paraguay (Pegler, 1983). Tropical species (Corner, 1981).

* *Megasporoporia setulosa* (Henn.) Rajch., Mycotaxon 16: 180, 1982.

SPECIMEN NUMBER: **CR-79.

TYPE OF ROT: White rot.

SUBSTRATE: On branch of unidentified wood; on angiosperms (Ryvarden *et al.*, 1982).

DISTRIBUTION: Pantropical (Ryvarden *et al.*, 1982).

Microporellus obovatus (Jungh.) Ryv., Norw. J. Bot. 19 (3-4): 232, 1972.

SPECIMEN NUMBER: CR-65.

TYPE OF ROT: White rot.

SUBSTRATE: Unidentified trunk on soil; on dead hardwoods, rarely on conifers (Gilbertson & Ryvarden, 1987).

DISTRIBUTION: Venezuela (Patouillard & Gaillard, 1888; Chardon & Toro, 1934; Dennis, 1970). *Petaloides mutabilis* in Venezuela (Fidalgo, 1968).

Nigroporus durus (Jungh.) Murr., Bull. Torrey Bot. Cl. 34: 471, 1907.

SPECIMEN NUMBER: **CR-02.

TYPE OF ROT: White rot.

SUBSTRATE: On unidentified hardwood.

DISTRIBUTION: Pantropical species (Ryvarden & Johansen, 1980).

Nothopanus hygropanus (Mont.) Singer in Pegler, Kew Bull. 23: 247, 1969.

SPECIMEN NUMBER: **CR-28.

TYPE OF ROT: Brown rot.

SUBSTRATE: On branch of caramacate.

DISTRIBUTION: Pantropical, in Venezuela and Brazil (Corner, 1981). French Guiana (Pegler, 1983). Trinidad (Dennis, 1970).

Panus strigellus Berk. in Berk. & Curtis, Jour. Linn. Soc. 10: 302, 1868.

SPECIMEN NUMBER: CR-115.

TYPE OF ROT: White rot?

SUBSTRATE: On log of algarrobo.

DISTRIBUTION: Venezuela, Mexico, Salvador, Cuba, Guadalupe, Martinique, Brazil, Paraguay, Colombia, Peru, and Argentina (Pegler, 1983). Brazil (Saccardo, 1887).

**Phellinus durissimus* (Lloyd) Roy., Mycologia, 71: 1006, 1979.

SPECIMEN NUMBER: **CR-30, **CR-45.

TYPE OF ROT: White rot.

SUBSTRATE: On living stem of caramacate and stump of *Carapa guianensis* Aubl. (carapa), on *Swietenia mahogani* Jacq., *Casuarina equisetifolia* L., *Mimusops elengi* L. (Larsen & Cobb-Pouille, 1990).

DISTRIBUTION: In eastern American and African tropics (Larsen & Cobb-Pouille, 1990).

Phellinus fastuosus (Lév.) Ryv., Norw. J. Bot. 19: 234, 1972.

SPECIMEN NUMBER: CR-13.

TYPE OF ROT: White rot.

SUBSTRATE: On stem of caramacate in living tree; on hardwood trees (Carranza-Morse, 1992); on dead hardwood in many genera (Larsen & Cobb-Pouille, 1990); on bark or decorticated wood of dead fallen branches and trunks, *Dillenia*, *Eubothrium* (Cunningham, 1965); on dead hardwood in many genera (Gilbertson & Ryvarden, 1987).

DISTRIBUTION: *Fomes fastuosus* in Venezuela (Dennis, 1970). *Fulvifomes fastuosus* (Holmquist, 1972). Widespread in tropics (Larsen & Cobb-Pouille, 1990).

Phellinus gilvus (Schw.) Pat., Essai Taxon. Hymenom. 97, 1900.

SPECIMEN NUMBER: CR-12, CR-94.

TYPE OF ROT: White rot.

SUBSTRATE: On Leguminosae, *Libidiba coriaria* (Jacq.) Schltdl. (dividive), and Euphorbiaceae, *Euphorbia* sp., *Sapium* sp. (Fidalgo & Fidalgo, 1968); on dead tree trunks (Fidalgo, 1968).

DISTRIBUTION: Amazonas and Bolivar states, widely distributed (Rogerson *et al.*, 1990). San Fernando de Atabapo in Amazonas state, Guatopo in Miranda state, and El Limon in Aragua state (Fidalgo, 1968). Trinidad, British Guiana, Venezuela, and Colombia (Dennis, 1970).

**Phellinus pectinatus* (Kl.) Quél., Enrich. Fung. P. 173, 1886.

SPECIMEN NUMBER: CR-42.

TYPE OF ROT: White rot.

SUBSTRATE: On stem of caramacate; on hardwood trees (Carranza-Morse, 1992); on deciduous wood (Larsen & Cobb-Pouille, 1990).

DISTRIBUTION: Pantropical (Ryvarden & Johansen, 1980). Java and Cuba (Larsen Cobb-Pouille, 1990). Central and South America, Africa, and Caribbean islands (Carranza-Morse, 1992). Panama (Dennis, 1970).

**Phellinus rhababarinus* (Berk.) Cunn., New Zeal. and Dep. Sci. Ind. Res. Bull. 164: 229, 1965.

SPECIMEN NUMBER: **CR-23.

TYPE OF ROT: White rot.

SUBSTRATE: On stump of caramacate; on bark of standing trunk and dead angiosperm (Larsen & Cobb-Pouille, 1990).

DISTRIBUTION: South America (Larsen & Cobb-Pouille, 1990).

Phellinus robineae (Murr.) Ames., Ann. Mycol. 11(3): 246, 1913.

SPECIMEN NUMBER: **CR-11.

TYPE OF ROT: White rot.

SUBSTRATE: On living stem of caramacate. Primary host is *Robinia* sp., also *Acacia* sp., *Castanea* sp., *Juglans* sp., *Prosopis* sp., *Quercus* sp., and *Coccolobis* sp. (Larsen & Cobb-Pouille, 1990).

DISTRIBUTION: Trinidad and Venezuela, as *Fomes robiniae* (Dennis, 1970).

**Phellinus robustus* (Karst.) Bourd. & Galz., Hym. France, 616, 1928.

SPECIMEN NUMBER: **CR-41.

TYPE OF ROT: White rot.

SUBSTRATE: On stem of caramacate; on hardwood and softwood trees (Carranza-Morse, 1992).

DISTRIBUTION: North, Central, and South America, and Caribbean Islands (Carranza-Morse, 1992). Jamaica (Larsen & Cobb-Pouille, 1990).

Phellinus sancti-georgii (Pat.) Ryv., Norw. J. Bot. 19: 235, 1972.

SPECIMEN NUMBER: **CR-38.

TYPE OF ROT: White rot.

SUBSTRATE: On living tree of caramacate; on deciduous wood (Larsen & Cobb-Pouille, 1990); on hardwood trees (Carranza-Morse, 1992).

DISTRIBUTION: Ecuador (Dennis, 1970). Central and South America, and Caribbean Islands (Carranza-Morse, 1992). Tropical America and Jamaica (Larsen & Cobb-Pouille, 1990).

**Pleurotus flavo-lanatus* (Berk. & Curtis) Sacc., Syll Fung. 5: 376, 1887.

SPECIMEN NUMBER: **CR-66.

TYPE OF ROT: White rot.

SUBSTRATE: On stem of *Simaruba amara* Aubl. (cedro blanco); on dead heliconia (Dennis, 1970).

DISTRIBUTION: Trinidad (Dennis, 1970). Cuba, Central America (Saccardo, 1887).

**Pleurotus ostreatus* (Jacq.: Fr.) Kumm., Der Führer in die Pilz Kunds. 104, 1871.

SPECIMEN NUMBER: **CR-34.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of dead mureillo.

DISTRIBUTION: Cosmopolitan (Singer, 1949).

Podoscypha venustula (Speg.) Reid, Nova Hedwigia, a monograph of the stipitate steroid

fungi. 18 p. 260, 1965.

SPECIMEN NUMBER: **CR-06.

TYPE OF ROT: Brown rot?

SUBSTRATE: On fallen branches; on dead wood.

DISTRIBUTION: Venezuela, Panama as *Stereum flabellatum* Pat. (Dennis, 1970).

Amazonas state (Rogerson *et al.*, 1990). South America, Brazil, Guadalupe, Panama, Paraguay, Ecuador, Peru, and Venezuela (Reid, 1965).

Polyporus arcularius Batsch:Fr., Syst. Mycol. 1: 342, 1821.

SPECIMEN NUMBER: **CR-68.

TYPE OF ROT: White rot.

SUBSTRATE: On branches of dead hardwood; on dead wood (Murrill, 1915; Overholts, 1953) on compositae, Fagaceae, Lauraceae, Myrtaceae, Podocarpaceae, and Violaceae (Cunningham, 1965).

DISTRIBUTION: Bolivar state (Rogerson *et al.*, 1990). Trinidad (Dennis, 1970).

Mexico, Costa Rica, Jamaica, Cuba, and Florida (Murrill, 1915). Common in Brazil (Rick, 1960). Transcontinental (Gilbertson & Ryvarden, 1987).

Polyporus tricholoma Mont., Ann. Sci. Nat. Ser. 2, 8: 365, 1837.

SPECIMEN NUMBER: CR-10

TYPE OF ROT: White rot.

SUBSTRATE: On dead wood of hardwood.

DISTRIBUTION: Trinidad, Venezuela, and Ecuador (Dennis, 1970). In Bolivar state (Rogerson *et al.*, 1990) .

**Postia floriformis* (Quéf. in Bres.) Jülich, Persoonia, 11(4): 423, 1982.

SPECIMEN NUMBER: **CR-23.

TYPE OF ROT: Brown rot.

SUBSTRATE: On dead hardwood; on dead conifers. Rare on hardwoods, but reported on *Acer* (Overholts, 1953); on bark and branches on the soil, usually on Fagaceae and Pinaceae (Cunningham, 1965); on dead hardwood and conifers (Gilbertson & Ryvarden, 1987).

DISTRIBUTION: Eastern and western North America (Gilbertson & Ryvarden, 1987).

Pycnoporus sanguineus (L.:Fr.) Murr., Bull. Torrey Bot. Club 31: 412, 1904.

SPECIMEN NUMBER: **CR-35, CR-75, **CR-92.

TYPE OF ROT: White rot.

SUBSTRATE: On unidentified hardwood; common on dead wood of *Pinus caribaea* var. *hondurensis*; frequently on rotted logs (Rick, 1960); on living trees (Rogerson *et al.*, 1990).

DISTRIBUTION: Widespread in Venezuela (Fidalgo, 1968). In Monagas, Bolivar, and Amazonas states (Rogerson *et al.*, 1990). Common, widely distributed in subtropical and tropical regions (Garcia & Stevenson, 1942). Common in South America (Gilbertson & Ryvarden, 1987).

Rigidoporus lineatus (Pers.) Ryv., Norw. J. Bot. 19: 236, 1972.

SPECIMEN NUMBER: **CR-119, CR-14.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of *Simaruba cedron* Planch. (cedro amargo); on saprophyte and wound parasite of deciduous trees (Ryvarden & Johansen, 1980).

DISTRIBUTION: In El Limon, as *Microporus plumbens* (Sydow, 1930). *Polyporus zonalis*, Dennis (1970). *Polyporus zonalis*, Overholts in Chardon & Toro (1934). Widespread in the subtropical and tropical zones (Gilbertson & Ryvarden 1987).

Rigidoporus microporus (Fr.) Van Overeen, IC. Fung. Malay. 5:1, Tab. 5, 1924.

SPECIMEN NUMBER: **CR-25.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of unidentified hardwood; common on hardwood (Van Overeen and Weese, 1924); frequent on dead wood (Murrill, 1915); on old electrical post (Spegazzini, 1926); on branches of hardwood (Cunningham, 1965).

DISTRIBUTION: Aragua and Miranda states (Fidalgo, 1968). Widely collected in Amazonas, Bolivar, and Delta Amacuro states (Rogerson *et al.*, 1990). Mexico (Saccardo, 1888; Murrill, 1915; Van Overeen & Weese, 1924; Cunningham, 1965). In Cuba and Puerto Rico (Murrill, 1915). In Argentina and Brazil (Spegazzini, 1965). In Costa Rica (Carranza & Saenz, 1984), In Antilles and Guiana (David & Rajchenberg, 1985). Widely distributed in tropics (Gilbertson & Ryvarden, 1987).

**Rigidoporus umboncetipes* Rajchenberg., Mycotaxon 28(1): 111-118, 1987.

SPECIMEN NUMBER: CR-124.

TYPE OF ROT: White rot.

SUBSTRATE: On branch of unidentified hardwood; on *Pinus* sp., and *Salix humboldtiana* Auth. (Rajchenberg, 1987).

DISTRIBUTION: Tropical and subtropical areas (Rajchenberg, 1987).

Rigidoporus vinctus (Berk.) Ryv., Norway J. Bot. 19: 139, 1972.

SPECIMEN NUMBER: **CR-09.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of dead *Alexa imperatricis* (Schomb.) Baill (leche cochino).

DISTRIBUTION: Common in tropics (Lowe, 1966). In Antilles and Guiana (David & Rajchenberg, 1985). From subtropics (Farr *et al.*, 1989).

COMMENT: In Venezuela, common on dead and on rotting hardwood. In Barinas state (Valverde, 1982). In Distrito Federal (Setliff, 1984). *Poria carneophallens* Berk. (Fidalgo, 1968).

Schizophyllum fasciatum Pat., J. Bot. 1. 170, 1887.

SPECIMEN NUMBER: **CR-96.

TYPE OF ROT: White rot.

SUBSTRATE: On log of algarrobo; on dead wood (Linder, 1933).

DISTRIBUTION: In Monagas state (Rogerson *et al.*, 1990). Aragua state (Dennis, 1970). Tropical (Linder, 1933).

Tinctoporellus epimiltinus (Berk. & Br.) Ryv., Trans. Br. Mycol. Soc. 73: 18, 1979.

SPECIMEN NUMBER: **CR-55.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of carapa; on dead standing and fallen hardwoods (Gilbertson & Ryvarden, 1987).

DISTRIBUTION: Trinidad, British Guiana, Venezuela, Colombia, and Panama as *Poria borbonica* (Dennis, 1970); *Poria borbonica* Pat. in Venezuela (Fidalgo, 1968). Pantropical (Gilbertson & Ryvarden, 1987).

**Trametes cervina* (Schw.) Bres., Ann. Mycol. 1: 81, 1903.

SPECIMEN NUMBER: **CR-52.

TYPE OF ROT: White rot

SUBSTRATE: On stem of caramacate; on dead wood of numerous genera of hardwoods; rarely on conifers (Gilbertson & Ryvarden, 1987).

DISTRIBUTION: Common in southwest of North America (Gilbertson & Ryvarden, 1987).

Trametes cubensis (Mont.) Sacc., Syll. Fung. 9: 198, 1891.

SPECIMEN NUMBER: **CR-90, **CR-91, **CR-96, **CR-97, **CR-126, **CR-89, **CR-103.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of unidentified hardwood, zapatero, and algarrobo; on dead hardwood in numerous genera (Gilbertson & Ryvarden, 1987).

DISTRIBUTION: In Venezuela (Fidalgo, 1968). Aragua state, San Juan de Los Morros. Common in tropical America (Lloyd, 1915). In tropical America, south to Brazil (Gilbertson & Ryvarden, 1986).

COMMENT: This is the first report of this species causing rot on hardwoods of economic importance—zapatero and algarrobo.

Trametes elegans (Spreng.:Fr.) Fr., Epicr. Syst. Mycol. p. 492, 1838.

SPECIMEN NUMBER: **CR-01, **CR-118, **CR-63.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of dead leche cochino. *Andira inermis* and *Ficus tobagensis* (Fidalgo & Fidalgo, 1968); on hardwood (Farr *et al.*, 1989); on decorticated wood, Maranthaceae and Moraceae (Cunningham, 1965).

DISTRIBUTION: In Venezuela, Rancho Grande Aragua, and Miranda states (Fidalgo, 1968). In Barinas state, as pantropical species (Holmquist, 1972). In Bolivar state (Rogerson *et al.*, 1990). Pantropical, common in areas with seasonal drought where fruitbodies survive from one season to another (Ryvarden & Johansen, 1980).

Trametes membranacea (Sw.:Fr.) Kreisel, Cs. Biol. Ser. 4, 16: 83, 1971.

SPECIMEN NUMBER: **CR-125.

TYPE OF ROT: White rot.

SUBSTRATE: On log of *Enterolobium cyclocarpum* (Jacq.) Grise. (caracaro); on dead hardwood, rarely on conifers (Gilbertson & Ryvarden, 1987).

DISTRIBUTION: Trinidad, British Guiana, Venezuela, as *Polystictus membranaceus* (Dennis, 1970). Venezuela, in Aragua state as *Microporus membranaceus* (Sydow, 1930), Amazonas and Bolivar states (Rogerson *et al.*, 1990). French Antilles and Guiana (David & Rajchenberg, 1985). Widespread throughout tropical America to northern Argentina (Gilbertson & Ryvarden, 1987).

Trichaptum sector (Ehremb.:Fr.) Kreisel, Cs. Ser. 4 Cs. Biol. 16: 84, 1971.

SPECIMEN NUMBER: **CR-32.

TYPE OF ROT: White rot.

SUBSTRATE: On branch of caramacate; on dead hardwoods, rarely on conifers (Gilbertson & Ryvarden, 1987).

DISTRIBUTION: Trinidad, British Guiana, Venezuela, Colombia and Ecuador, as *Polyporus sector* (Dennis, 1970). In Venezuela, as *Polystictus sector* (Sydow, 1930; Dennis, 1965). In Aragua, Miranda, and Merida states and Distrito Federal as *Microporus sector* (Fidalgo, 1968a).

**Tyromyces hydrophilus* (Berk. & Curtis) Lowe, Mycotaxon 2: 46, 1975.

SPECIMEN NUMBER: **CR-139.

TYPE OF ROT: White rot.

SUBSTRATE: On trunk of cedro amargo; on deciduous wood (Ryvarden & Johansen, 1980).

DISTRIBUTION: Cuba and British Honduras (Lowe, 1975).

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Table 1—Host/substrate index for Venezuelan collections

Host/substrate	Fungus
<i>Diplotropis purpurea</i> (congrío)	<i>Antrodia albida</i> , <i>Auricularia polytricha</i> , <i>Gloeophyllum striatum</i>
<i>Jacaranda capaia</i> (simaruba)	<i>Earliella scabrosa</i>
<i>Hymenea courbaril</i> (algarrobo)	<i>Earliella scabrosa</i> , <i>Lentinus scleropus</i> , <i>Panus</i> <i>atrigenellus</i> , <i>Schizophyllum fasciatum</i> , <i>Trametes</i> <i>cubensis</i>
<i>Acacia</i> sp.	<i>Hexagonia hydroides</i>
<i>Piranhea rongepedunculata</i> (caramacate)	<i>Nothopanus hygropanus</i> , <i>Phellinus durissimus</i> , <i>P. fastuosus</i> , <i>P. pactinatus</i> , <i>P. rhababarinus</i> , <i>P. robineae</i> , <i>P. robustus</i> , <i>P. sancti-georgii</i> , <i>Trametes cervina</i> , <i>Trichaptum sector</i>
<i>Carapa guianensis</i> (carapa)	<i>Phellinus durissimus</i> , <i>Tinetoporellus epimiltinus</i>
<i>Libidiba coriaria</i> (dividive)	<i>Phellinus gilvus</i>
<i>Euphorbia</i> sp.	<i>Phellinus gilvus</i>
<i>Sapium</i> sp.	<i>Phellinus gilvus</i>
<i>Simaruba amara</i> (cedro blanco)	<i>Pleurotus flavolanatus</i>
<i>Erisma uncinatum</i> (mureillo)	<i>Pleurotus ostreatus</i>
<i>Simaruba cedron</i> (cedro amargo)	<i>Rigidoporus lineatus</i> , <i>Tyromyces hydrophilus</i>
<i>Alexa imperatricis</i> (leche cochino)	<i>Rigidoporus vinctus</i> , <i>Trametes elegans</i>
<i>Peltogyne porphyrocardia</i> (zapatero)	<i>Trametes cubensis</i>
<i>Enterolobium cyclocarpum</i> (caracaro)	<i>Trametes membranacea</i>
<i>Pinus caribaea</i> var. <i>hondurensis</i> (Pino caribe)	<i>Gloeophyllum striatum</i> , <i>Pycnoporus sanguineus</i>
Unidentified hardwood	<i>Coriolopsis caperata</i> , <i>Cyclomyces iodinus</i> , <i>Dacryopinax indacocheae</i> , <i>D. spathularia</i> , <i>Fomitopsis feei</i> , <i>Hymenochaete luteo-badia</i> , <i>Megasporoporia setulosa</i> , <i>Microporellus</i> <i>obovatus</i> , <i>Nigroporus durus</i> , <i>Podoscypha</i> <i>venustula</i> , <i>Polyporus arcularius</i> , <i>P. tricholoma</i> , <i>Postia floriformis</i> , <i>Pycnoporus sanguineus</i> , <i>Rigidoporus microporus</i> , <i>R. umboncetipes</i>

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A SYNOPTIC KEY TO SPECIES OF THE *ASPERGILLUS NIDULELLUS*- *EMERICELLA* ASSEMBLAGE COMMON TO EGYPT

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Abstract

A large number of isolates belonging to *Aspergillus nidulellus*-*Emericella* taxa were commonly isolated from a variety of substrates such as soil, spices, foodstuffs, seeds, grains, dust, air, pollen grains, etc. The number of isolates investigated for each species was as follows: *Emericella acristata* (3 isolates); *E. aurantiobrunnea* (2), *E. bicolor* (1), *E. dentata* (12), *Aspergillus egyptiacus* (6), *E. nidulans* (5), *E. parvathecia* (1), *E. quadrilineata* (44), *E. rugulosa* (8), *E. striata* (2), *E. sublata* (1), *E. unguis* (2) and *E. varicolor* (2). A synoptic key for the identification of these thirteen taxa is presented. The key uses definitive and readily observable features: colony appearance with specified growth conditions (using two cultural media and two incubation temperatures), stipe length, ascospore morphology and cleistothecia diameter. Brief descriptions are made for treated taxa. As no epithets are available for three anamorphs (treated here), we propose: *Aspergillus aurantiobrunneullus* st. nov., *Aspergillus dentatulus* st. nov. and *Aspergillus acristatulus* st. nov. for *Emericella aurantiobrunnea*, *E. dentata* and *E. acristata*, respectively.

Introduction

When Micheli (1729) introduced *Aspergillus* for anamorphic fungi, he also described taxa under the generic name *Eurotium* (The teleomorph of *Aspergillus reptans*). Subsequently other teleomorphs of *Aspergillus* species were described such as *Emericella* was introduced by Berkeley & Broome (1857) to accommodate *A. stellifer*. Benjamin (1955) compared the teleomorphs of *Aspergillus* taxa and on the basis of differences in cleistothecial development he selected the previously published generic names *Eurotium* Link (1809) for the *A. glaucus* group, *Emericella* Berkeley & Broome (1857) for *A. nidulellus* group and *Sartorya* Vuillemin (1927) for *A. fumigatus* group. Raper & Fennell (1965) considered that the use of different generic names for teleomorphs served no useful purpose, but Malloch & Cain (1972a) accepted the generic name *Emericella* for the

teleomorph of the *A. nidulellus* group and also they (1972a,b) introduced several new generic names for the other teleomorphs of different *Aspergillus* groups. Also Molloch & Cain (1972a, 1973) adopted the family name Trichocomaceae E. Fischer (Nat. Pflanzenfam. 1 (1): 310.1897) for cleistothecial Ascomycetes with *Aspergillus*, *Paecilomyces* and *Penicillium* imperfect states. However, Von Arx (1987) included *Emericella* in the order Eurotiales and the Family Eurotiaceae Clem. & Shear, (Gen. Fung. P. 50, 1931) stating that the Eurotiaceae are characterized by equally bivalvate, often saturn-shaped and ornamented ascospores and by ascoma with a well-developed peridium.

Emericella Berkeley & Broome, 1857, Berkeley's, Introduction to cryptogamic Botany, p. 340-341.
Type species: *E. variegata* Berkeley & Broome, 1857, Berkeley's Introduction to Cryptogamic Botany, p. 340-341.

Description: *Emericella* is characterized by ascocarps embedded in dense masses of thick-walled Hülle cells. The ascocarps globose, yellowish to red occurring singly or in groups. Asci irregularly disposed, subglobose to globose, evanescent. Ascospores bivalvate, orange to purple red or blue violet, smooth or roughened on the faces. Conidial stage *Aspergillus* with conidiophores bearing phialides on metulae. Hülle cells was considered to be the most significant characteristic of *Emericella* (Malloch & Cain 1972b).

Raper & Fennell (1965) discussed thoroughly the *Aspergillus nidulellus* group providing a dichotomous key to species and full descriptions for 23 taxa. Christensen & Raper (1978) included 7 new species described since 1965 (Baghdadi 1968, Mehrotra & Prasad 1969, Moubasher & Moustafa 1972, Samson & Mouchacca 1974, 1975, Christensen *et al.* 1978) in their synoptic key for the identification of the 30 taxa. *Aspergillus mellinus* described by Novobranova (1972) was considered to be indistinguishable from *A. unguis* (Samson 1979, Christensen & States 1982). *Emericella nivea* that was firstly described by Wiley & Simmons (1973) as the ascospore stage of *A. niveus* was rejected as a member of *Emericella* (Christensen & Raper 1978, Samson 1979) and included in the genus *Fennellia* (Samson 1979) because of the hyaline to pale yellow ascospores, elongate Hülle cells and white to buff heads. Also, Christensen & Raper (1978) have omitted *A. speluneus*, *A. caespitosus* and *A. silvaticus* from Raper & Fennell (1965)'s *A. nidulans* group. However, Koza-kiewicz (1989) placed *A. silvaticus* in her new species group (*A. deflectus* group) and accepted *A. speluneus* in *A. versicolor* group and she believed that *A. caespitosus* is better placed in *A. nidulans* group. Horie (1980) published a beautiful scanning electron photomicrographs showing ascospore ornamentation in 22 taxa belonging to this assemblage together with certain colony features making a synoptic key for 26 (*Fennellia nivea* was included) taxa: the 21

ascosporic taxa included in Christensen & Raper (1978) and 4 newly described by Udagawa & Horie (1976), Horie (1978, 1979) and Udagawa & Muroi (1979). Christensen & States (1982) described a new *Emericella* species and revised their synoptic key to accommodate the 4 new species described since 1978. This key included 34 taxa (27 ascosporic and 7 nonascosporic). Since 1982, 4 new species have been described (3 ascosporic: *E. undulata* Kong & Qi 1986, *E. falconensis* Horie et al. 1989, *E. similis* Horie et al. 1990; and a non-ascosporic species *A. subunguis* Wadhwani et al. 1984). Thus, the assemblage now includes 38 (or 39) taxa (30 belonging to *Emericella* and 8 with *Aspergillus* anamorphs only or (9) if the opinion of Kozakiewicz (1989) that *A. caespitosus* is better placed in *A. nidulans* group, was considered).

Materials and Methods

Eighty-nine isolates of *Aspergillus nidulellus*-*Emericella* taxa commonly isolated from Egypt were investigated. For identification, isolates should be grown on Czapek Dox agar and 10% NaCl-Malt extract agar at 25°C and on Czapek Dox agar at 40°C in dark for 7 days. For cleistothecial maturation in some species, incubation for longer periods (more than 14 days) may be required. To use the synoptic key designed herein for the common Egyptian taxa, follow the method of either Korf (1972) or Christensen & Raper (1978). The virtues of a synoptic key as pointed out by Korf (1972) include (1) ease to entry, one begins at any point; (2) flexibility; the system is suited to modification and expansion by addition; (3) a means for accommodating disc-repancies.

The taxa treated in the present synoptic key are listed alphabetically in table (1). Before assuming that a selected name is correct for an unknown isolate, the user should compare salient features against both the brief descriptions given here (in the Brief Descriptions section of this paper) and the full description of the candidate taxon found in Raper & Fennell (1965) and the other publication appeared for new taxa of this assemblage since 1965 up to now.

Table 1: Alphabetical list of *Aspergillus nidulellus*-*Emericella* taxa treated in this study.

1-	<i>Emericella acristata</i> (Fennell & Raper) Horie
2-	<i>E. aurantio-brunnea</i> (Atkins, Hindson & Russell) Malloch & Cain
3-	<i>E. bicolor</i> Christensen & States
4-	<i>E. dentata</i> (Sandhu & Sandhu) Horie
5-	<i>Aspergillus egyptiacus</i> Moubasher & Moustafa
6-	<i>E. nidulans</i> (Eidam) Vuillemin
7-	<i>E. parvathecia</i> (Raper & Fennell) Malloch & Cain
8-	<i>E. quadrilineata</i> (Thom & Raper) C.R. Benjamin
9-	<i>E. rugulosa</i> (Thom & Raper) C.R. Benjamin
10-	<i>E. striata</i> (Rai, Tewari & Mukerji) Malloch & Cain
11-	<i>E. subblata</i> Horie
12-	<i>E. unguis</i> Emile-Weil & Gaudin
13-	<i>E. varicolor</i> Berkeley & Broome

Synoptic key to species treated
Colony features

- 1 - Restricted growth on Czapek agar: colony diam less than 20 mm after 7 days at 25°C 4 , 5 , 9 , 13
Growth not restricted on Czapek agar: colony diam more than 20 mm 1 , 2 , 3 , 4 , 6 , 7 , 8 , 10 , 11 , 12 , 13
- 2 - Colony diam after incubation on Czapek agar at 40°C for 7 days:
No growth 3
Diam less than 25 mm 5 , 9 , 13
Diam from 25-40 mm 4 , 6 , 7 , 8 , 12
Diam more than 40 mm 1 , 2 , 6 , 8 , 10 , 11
- 3 - Colony diam after incubation on 10% NaCl-MA at 25°C for 7 days:
Diam less than 25 mm 1 , 2 , 3 , 4 , 6 , 7 , 8 , 9 , 10 , 11 , 12 , 13
Diam more than 25 mm 1 , 5 , 6 , 8 , 10 , 11
- 4 - Colony colour on Czapek agar at 25°C:
- Gray to yellowish gray or grayish yellow 5
- Grass green-dark green 6 , 7 , 9 , 11 , 12
- Light yellow-beige 1 , 3 , 4 , 6 , 8 , 9 , 10
- Orange white, pale orange or orange gray to olive 2,8
- Grayish yellow, grayish green, olive to olive brown 4 , 8 , 13
- 5 - Colony reverse on Czapek agar at 25°C:
- Grayish yellow-yellowish gray 5
- Grayish red, grayish brown to dark brown 1 , 4 , 6 , 7 , 8 , 9 , 11 , 12

- Orange, brownish orange to deep brown 1 , 2 , 3 , 4 ,
6 , 8 , 9 , 10
 - Light yellow to olive brown 13
- 6 Colony reverse diffusible on Czapek agar at 25°C
2 , 3 , 6 , 8 , 9 , 12
Colony reverse not diffusible
1 , 2 , 3 , 4 , 5 , 6 , 7 , 8 , 9 , 10 , 11 , 13
- 7 - Exudate colourless on Czapek agar at 25°C
1 , 2 , 4 , 5 , 6 , 7 , 8 , 9 , 10 , 13
Exudate dark brown 2
Exudate orange white 9
Exudate not produced 3 , 4 , 8 , 11 , 12
- 8 - Colony profile raised on Czapek agar at 25°C
1 , 2 , 3 , 4 , 6 , 8 , 10 , 13
Colony profile raised and lobed 4 , 9
Colony profile flat 5 , 11 , 12
Colony profile spreading 1 , 6 , 7 , 8
- 9 - Colony profile raised on Czapek agar at 40°C
4 , 5 , 9 , 13
Colony profile spreading
1 , 2 , 4 , 6 , 7 , 8 , 9 , 10 , 11 , 12
- 10- Sectors produced on Czapek agar at 25°C
1 , 2 , 3 , 4 , 6 , 7 , 8 , 10
Sectors not produced
1 , 2 , 4 , 5 , 6 , 8 , 9 , 11 , 12 , 13
- 11- Sectors produced on Czapek agar at 40°C
1 , 2 , 4 , 7 , 8 , 9 , 10 , 11 , 13
Sectors not produced
1 , 2 , 4 , 5 , 6 , 8 , 9 , 10 , 12 , 13

Microscopic measurements

- 12- Cleistothecia diam less than 200 μm 7 , 11
Cleistothecia diam 200 μm or more
1 , 2 , 3 , 4 , 6 , 8 , 9 , 10 , 13
Cleistothecia not produced 5 , 12
- 13- Hülle cells produced
1 , 2 , 3 , 4 , 5 , 6 , 7 , 8 , 9 , 10 , 11 , 13
Hülle cells not produced 5 , 12
- 14- Stipe less than 50 μm long 5
Stipe less than 100 μm long 7
Stipe more than 100 μm long 1 , 2 , 3 , 4 , 6 , 8 ,
9 , 10 , 11 , 12 , 13
- 15- Stipe becoming brown-pigmented 1 , 2 , 3 , 4 , 6 , 7 ,
8 , 9 , 11 , 12 , 13

Stipe hyaline 5, 10

- 16- Ascospore convex wall smooth
1, 2, 3, 4, 6, 7, 8, 11, 13
Ascospore convex wall rugulose, ridged, not smooth
3, 9, 10
- 17- Ascospore crests lacking
1, 3, 10
Ascospore crests present, two in number
1, 2, 3, 4, 6, 7, 8, 9, 11, 13
Ascospore crests four or multiple and irregularly
arranged 8, 10
- 18- Ascospore crests well-developed, commonly extending
1.7 μ m or more outward from spore body.
11, 13
Ascospore crests incised, spores stellate in pattern
13
Ascospore crests up to 0.8-1.5 μ m wide
2, 4, 6, 8, 11
Ascospore crests 0.6 μ m wide or less
1, 3, 4, 7, 8, 9, 10

Brief descriptions of included taxa

Brief descriptions of the most common taxa isolated from Egypt are given below, the complete description may be found in Raper & Fennell (1965), and for *Emericella bicolor* in Christensen et al. (1978), *A. egyptiacus* in Moubasher & Moustafa (1972) and Samson & Mouchacca (1974), and for *E. sublata* in Horie (1979).

- 1 - *Emericella acristata* (Fennell & Raper) Horie, 1980, Trans. mycol. Soc. Japan 21: 483-493.

Common Synonyms

- = *Emericella nidulans* (Eidam) Vuill. var. *acristata*
(Fennell & Raper) Subramanian, 1972, Cur. Sci. 41:758
= *Aspergillus nidulans* (Eidam) Wint. var. *acristatus*
Fennell & Raper, 1955, Mycologia 47: 79.

Anamorph: *Aspergillus acristatulus*

Ismail, Abdel-Sater & Zohri, St. nov.

Colonies on Czapek agar at 25°C 24-31 mm diam in 7 da, with light yellow to beige colour (M: 4 A-D 3-4) (Kornerup & Wanscher 1989); deep orange, brown to dark brown reverse and colourless exudate. Growth enhanced at 40°C (43-51 mm diam in 7 da) with grayish yellow to olive yellow appearance (M: 2 C-D 4-6) and reddish orange to brown reverse. Colonies may form sectors on Czapek's agar either at 25° or 40°C. Stipe up to 150 μ m long; conidia 2.5-4.5 μ m; Hülle cells up to 30 μ m. Cleistothecia up to 375 μ m diam; ascospore size is 3-3.5 μ m; crests lacking or 2 very narrow crests.

- 2 - *Emericella aurantio-brunnea* (Atkins, Hindson & Russell) Malloch & Cain, 1972, Can. J. Bot. 50: 61.

Common Synonyms:

= *Emericella nidulans* (Eidam) Vuill. var. *aurantio-brunnea* Atkins, Hindson & Russell, 1958, Trans. Br. mycol. Soc. 41: 501-504.

= *Aspergillus aurantio-brunneus* (Atkins, Hindson & Russell) Raper & Fennell, 1965, apud Raper & Fennell, The Genus *Aspergillus*: 511.

Anamorph: *Aspergillus aurantiobrunneullus*

Ismail, Abdel-Sater & Zohri, St. nov.

Colonies on Czapek agar at 25°C raised, with olive colour (M: 2 E-F 3-4) and orange white sectors (M: 6A2); reverse orange to dark brown. Colonies on Czapek agar at 25°C restricted (25-32 mm diam in 7 da) while enhanced spreading growth at 40°C (44-49 mm). Exudate on Czapek agar at 25°C colourless or dark brown. Stipe 20 to 175 μm long; conidia 2-3.5 μm diam and Hülle cells up to 25 μm . Maturation of cleistothecia (250 μm diam) requires more than 2 weeks.

- 3 - *Emericella bicolor* Christensen & States, 1978, Mycologia 70: 332-343.

Anamorph: *Aspergillus bicolor* Christensen & States, Loc. cit.

Colonies on Czapek agar raised, 25 mm in diam after 7 da at 25°C, light yellow to beige (M: 4 A-D 3-4) appearance with diffusing brownish orange to dark brown (M. 6 C-F 7) pigmentation; forming sectors with yellowish grey to greyish yellow colour (M: 4 B 2-3). No growth at 40°C. Reduced growth (14 mm in diam) was observed on Malt agar supplemented with 10% NaCl, giving raised, yellowish white to silver white (M: 2 A-B 2) colony with no reverse. Stipe 150 μm long; conidia subglobose to elliptical up to 4.5 μm size; Hülle cells up to 30 μm . Cleistothecia maturing tardily and up to 400 μm size; ascospores 4-5.5 μm with crests lacking or very low.

- 4 - *Emericella dentata* (Sandhu & Sandhu) Horie, 1980, Trans. mycol. Soc. Japan 21: 483-493.

Common Synonyms

= *Emericella nidulans* (Eidam) Vuill. var. *dentata* (Sandhu & Sandhu) Subramanian, 1972, Cur. Sci. 41: 758.

= *Aspergillus nidulans* (Eidam) Wint. var. *dentatus* Sandhu & Sandhu, 1963; Mycologia, 55: 297-299.

Anamorph: *Aspergillus dentatulus*

Ismail, Abdel-Sater & Zohri, St. nov.

Colonies on Czapek agar raised mostly lobed forming sectors at 25°C with restricted growth 9-15 (-29) mm diam in 7 da; colour grayish yellow to olive brown (M: 4 B-D 4) and in other strains light yellow to beige (M: 4 A-D 3-4); reverse ranging from yellowish-, reddish-,

orange-, to brown dependant on strain; colourless exudate mostly produced. 40°C enhanced growth, 15-24 (-39) mm diam in 7 da. Stipe tall ranging from 11-125 (-180) μm ; conidia 2-4.5 μm and Hülle cells 20-28 (-34) μm . Cleistothecia up to 500 μm (mostly 250-375 μm) and ascospores 3-5 μm with 2 crests conspicuously dentate.

- 5 - *Aspergillus egyptiacus* Moubasher & Moustafa, 1972, Egypt. J. Bot. 15: 153-154.

Colonies on Czapek agar at 25°C growing restrictedly attaining a diam of 11-17 mm within 7 da; gray to yellowish gray (M: 4 B 1-2) or gray to grayish yellow (M: 4 B 1-3) with grayish yellow (M: 4 B 3-4) or yellowish gray (M: 4 B 2) reverse; exudate colourless. 40°C enhanced growth slightly (17-23 mm) while MA amended with 10% NaCl gave twice growth or more (25-34 mm diam in 7 da at 25°C). Stipe hyaline, very short 5-35 μm long, mostly not arranged in a typical *Aspergillus*-head but phialides solitary or occurring in little groups along the stipe resembling *Penicillium*-like structures. Conidia globose or subglobose, smooth 3-5 μm . Hülle cells are produced in some strains, globose, subglobose or ellipsoidal up to 20 μm . Non-ascosporic species.

- 6 - *Emericella nidulans* (Eidam) Vuillemin, 1927, Compt. rend. Acad. Sci. Paris 184: 137.

= *Aspergillus nidulans* (Eidam) Winter, 1884, Rab. Krypt.-Fl. 1 (2): 62.

= *Sterigmatocystis nidulans* Eidam, 1883, Cohn, Beitr. Biol. Pflanz. 3: 392-411.

Anamorph: *Aspergillus nidulellus* Samson & W. Gams, 1985, Apud Samson & Pitt, Adv. *Penicillium*, *Aspergillus* System.: 44.

Colonies on Czapek agar 25-34 mm in diam after 7 da at 25°C with grass green to dark green colour (M: 30 E-F 7) or light yellow to beige in some strains (M: 4 A-D 3-4); reverse reddish, or orange to brown; mostly diffusible pigmentation produced; sectors may be produced. Growth spreading and enhanced at 40°C, while reduced on MA amended with 10% NaCl at 25°C. Stipe up to 130 μm ; conidia 2.5-5 μm ; Hülle cells mostly 25 μm but may reach 30 μm . Cleistothecia size ranged from 250-450 μm , ascospores 3.5-5.5 μm with two equatorial crests.

- 7 - *Emericella parvathecica* (Raper & Fennell) Malloch & Cain, 1972, Can. J. Bot. 50: 62.

Common Synonym:

= *Aspergillus parvathecicus* Raper & Fennell, 1965, The Genus *Aspergillus*: 509-511.

Anamorph: *Aspergillus microthecicus* Samson & W. Gams, 1985, apud Samson & Pitt, Adv. *Penicillium*, *Aspergillus* System.: 46-47.

Colonies on Czapek agar spreading, 31 mm in diam after 7 da at 25°C, with grass green to dark green colour (M: 30 E-F 7); diffusible pigmentation and grayish red to reddish brown reverse (M: 8 C-E 4); exudate colourless. 40°C enhanced growth slightly (36 mm diam) with orange yellow reverse (M: 4 B 7-8). Sectors are formed either at 25°C or 40°C. Stipe short mostly 20-70 μm long and conidia 2.5-4.5 μm ; Hülle cells up to 35 μm diam. Cleistothecia small (100 μm) and rarely up to 180 μm , ascospores 4-4.5 μm .

- 8 - *Emericella quadrilineata* (Thom & Raper) Benjamin, 1955, Mycologia 47: 680.

Common Synonym:

= *Aspergillus quadrilineatus* Thom & Raper, 1939, Mycologia 31: 660.

Anamorph: *Aspergillus tetrazonus* Samson & W. Gams, 1985 apud Samson & Pitt, Adv. *Penicillium Aspergillus* System.: 48.

Colonies on Czapek agar 20-33 (mostly 28 mm) in diam after 7 da at 25°C with shades of orange or reddish to dark brown colour; mostly diffusing pigmentation in the surrounding agar; colourless exudate mostly produced. Growth spreading and enhanced at 40°C, 31-51 (commonly above 45 mm diam) after 7 da. Stipe 20-100 μm long but in some strains up to 200 μm ; conidia 2.5-5 μm wide; Hülle cells up to 34 μm but commonly 25 μm . Cleistothecia about 250 μm in diam (-500 μm); ascospore body 3.5-6 μm with four equatorial crests.

- 9 - *Emericella rugulosa* (Thom & Raper) Benjamin 1955, Mycologia 47: 680-681.

Common Synonym:

= *Aspergillus rugulosus* Thom & Raper, 1939, Mycologia 31: 660-663.

Anamorph: *Aspergillus rugulovalvus* Samson & W. Gams, 1985, apud Samson & Pitt, Adv. *Penicillium Aspergillus* System.: 49.

Colonies on Czapek agar at 25°C restricted (9-13 mm diam), raised and lobed with exudate in colourless or orange white droplets. Enhanced growth at 40°C (14-31 mm) was achieved and grayish yellow to olive (M1: B-E 5-6) or olive (M: 3 E-F 7-8) with light yellow (M: 1 A 4-5) or white edge; reverse dark brown. Diffusing pigmentation mostly produced into the medium. Stipe ranging from 20-200 μm long; conidia 2.5-4.5 μm ; Hülle cells up to 35 μm . Cleistothecia ripening quickly up to 400 μm , ascospores with conspicuously rugulose convex walls and 2 narrow crests.

- 10- *Emericella striata* (Rai, Tewari & Mukerji) Malloch & Cain, 1972, Can. J. Bot. 50: 62.

Common Synonym:

= *Aspergillus striatus* Rai, Tewari & Mukerji, 1964, Can. J. Bot. 42: 1521-1524.

Anamorph: *Aspergillus striatulus* Samson & W. Gams 1985, apud Samson & Pitt, Adv. *Penicillium* *Aspergillus* System.: 50.

Colonies on Czapek agar raised, light yellow to beige (M: 4 A-D 3-4), 27-33 mm in diam after 7 da at 25°C; reverse light orange to yellowish brown; exudate colourless and sectors are formed. Colonies at 40°C spreading (48 mm diam), grayish yellow to olive brown colour; reverse grayish brown to violet brown. Stipe 45-140 μm tall; conidia 2.5-3.5 μm ; Hülle cells subglobose to ovate up to 25 μm in diam. Cleistothecia up to 350 μm ; ascospore with several low equatorial ridges continuous with striations in finger print-like patterns on the convex wall.

- 11- *Emericella sublata* Horie, 1979, Trans. mycol. Soc. Japan 20: 481.

Anamorph: *Aspergillus sublatulus* Horie, 1979; Trans. mycol. Soc. Japan 20: 481.

Colonies on Czapek agar at 25°C flat 29 mm diam, grass green to dark green (M: 30 E-F 7) in colour; reverse grayish brown. 40°C enhanced growth (44 mm diam in 7 da); colony colour grayish yellow to olive (M: 2 C-E 4-5); and with dark brown diffusing pigmentation. Stipe 20-125 μm long; conidia 4.5-6; Hülle cells 25 μm . Cleistothecia 175 μm wide, ascospores 5-6 μm , provided with two equatorial crests measuring 1-1.5 μm wide, commonly extending 1.7 μm or more outward from spore body, with convex surfaces smooth.

- 12- *Emericella unguis* Malloch & Cain, 1972, Can. J. Bot. 50: 62.

Anamorph: *Aspergillus unguis* (Emile-Weil & Gaudin) Thom & Raper, 1939, Mycologia 31 (6): 667-668
emended Fennell & Raper, Mycologia 17 (1): 78-79

Colonies on Czapek agar at 25°C flat, 22-28 mm diam with grass green to dark green (M: 30 E-F 7) colour; grayish brown reverse; and with diffusing pigmentation into the medium. Enhanced growth was achieved at 40°C (39 mm) and reduced at 25°C on MA amended with 10% NaCl. At 40°C colony dark green (M: 30 F 7-8) with greenish gray to dull green reverse (M: 30 D-F 2-3). Stipe up to 150 μm long; conidia 4-5 μm wide. A characteristic feature for this species is the presence of coarse spicular hyphae. Hülle cells not observed in our strains. Our strains non-ascosporic, in spite of the observation of a single isolate (WB 2392) with scattered cleistothecia in thin envelopes of globose Hülle cells (Christensen & Raper 1978).

- 13- *Emericella variegata* Berk. & Br., 1857; Berk., *Introd. Crypt. Bot.*; 340; Benjamin 1955, *Mycologia* 47: 679.

Common Synonyms:

= *Aspergillus variegata* (Berk. & Br.) Thom & Raper, 1939, *Mycologia* 31: 663-667; Raper & Fennell 1965, *The Genus Aspergillus*: 514.

= *Aspergillus stellatus* Curzi, 1934, *Rend. accad. nazl. Lincei* 19: 424-428.

Anamorph: *Aspergillus stellifer* Samson & W. Gams, 1985, apud Samson & Pitt, *Adv. Penicillium Aspergillus System.*: 52.

Colonies on Czapek agar at 25°C raised, 17-28 mm diam in 7 da; grayish yellow or olive to olive brown (M: 3-4 D-F 4); reverse light yellow to olive brown (M: 4 B-F 5); exudate colourless. It is worthed to mention that this is the only species treated here that 40°C inhibited its growth (apart from *E. bicolor* which has no growth at 40°C). Colonies at 40°C with greenish white to greenish gray shades (M: 30 A-D 2) or white to gray (M: 18 A-C 1). Stipe up to 250 µm long; conidia globose to subglobose roughened 2.5-3.5 µm wide; Hülle cells globose, subglobose (17x20 µm) or elongate (15x26) or up to 38 µm. Cleistothecia measuring 400-575 µm, ascospore body 3-4.5 µm (crests not included), with convex wall smooth and two conspicuously pleated stellate equatorial crests, 3-4 µm wide.

Discussion

Christensen & Raper (1978) in addition to other authors such as Mains (1950), Bakshi (1951) and Zycha *et al.* (1969) strongly supported that morphologies for all reproductive states should be considered at the species level. In the *Aspergillus nidulans*-*Emericella* assemblage, morphological features, conidial structures together with those of cleistothecia, ascospores and hülle cells provide a ready means to species separation. Certain features may or may not be needed in the synoptic key, but in a few cases are either diagnostic or supportive. Thus for example: a) *Aspergillus egyptiacus* is the only species with gray to yellowish gray or grayish yellow colony appearance and reverse, consistently with colony diam more than 25 mm on 10% NaCl- Malt extract agar at 25°C, and stipe less than 50 µm long; b) *Emericella bicolor* does not grow at 40°C on Capek Dox agar and with subglobose to elliptical conidia, c) *E. variegata* is the only species (within species investigated) with light yellow to olive reverse and also with ascospores stellate in pattern, d) *E. parvathecia* with a stipe less than 100 µm long, e) *A. egyptiacus*, *E. rugulosa* and *E. variegata* are the only three species attaining colony diam less than 25 mm on Czapek Dox agar at 40°C; *E. parvathecia* and *E. sublata* produce small cleistothecia with diam less than 200 µm; *A. egyptiacus* and *E. unguis* were the only two species (in the

current study) lacking cleistothecia; only *A. egyptiacus* and *E. striata* produce hyaline stipes; and *E. sublata* and *E. varicolor* were the only two species producing ascospores with well-developed crests commonly extending 1.7 μm or more outward from spore body.

Many species of this assemblage were first described including both anamorph and teleomorph and most of these species were typified by Samson & Gams (1985). As *Aspergillus aurantio-brunneus* (Atkins, Hindson & Russell) Raper & Fennell, *A. nidulans* var. *acristatus* Fennell & Raper and *A. nidulans* var. *dentatus* Sandhu & Sandhu were first described inclusive of teleomorphs and as no epithets are available for them, we propose the following anamorphs: *Aspergillus aurantiobrunneulus* st. nov., *Aspergillus acristatulus* st. nov. and *Aspergillus dentatulus* st. nov. for *Emericella aurantio-brunnea*, *Emericella acristata*, and *Emericella dentata*, respectively.

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Table 2: The mean, standard deviation and range of some measurements for taxa treated.

Taxon	Colony diameter (mm)					Microscopic measurements (μ m)				
	Czapek		NaCl-MA			Cleistothecia	Ascospores	Stipe	Conidia	Hulle cells
	25°C	40°C	25°C	25°C						
<i>E. acristata</i> (3)	27±3.6 (24-31)	48±4.4 (43-51)	24±3.6 (20-27)			312±63 (250-375)	5.2±0.58 (3-5.5)	138.3±12.6 (25-150)	4±0.5 (2.5-4.5)	26.7±2.9 (25-30)
<i>E. aurantio-brunnea</i> (2)	28.5±4.9 (25-32)	46.5±3.5 (44-49)	21±4.2 (18-24)			250±0	(4.5-5)	145±42.4 (20-175)	3.3±0.4 (2-3.5)	(22-25)
<i>E. bicolor</i> (1)	25±3	0	14±3			400	(4-5.5)	75-150	2.5-4.5	30
<i>E. dentata</i> (12)	15.9±6.3 (9-29)	23.5±6.5 (15-39)	15.8±4.6 (9-25)			358±84 (250-500)	5.1±0.33 (3-5.5)	151.1±26.9 (11-180)	3.7±0.5 (2-4.5)	27.3±3.6 (22-34)
<i>A. egyptiacus</i> (6)	15±2.2 (11-17)	19.5±2.7 (17-23)	30.7±3.1 (25-34)			-	-	28±9.7 (5-35)	5±0 (3-5)	14.7±6.1 (6-20)
<i>E. nidulans</i> (5)	30.1±3.3 (25-34)	40.2±3.4 (35-43)	23±4.3 (16-27)			310±89 (250-450)	5.2±0.27 (3.5-5.5)	111±18.2 (12-130)	4.2±0.6 (2.5-5)	26±2.3 (25-30)
<i>E. parvathecia</i> (1)	31±2	36±9	21±4			100-180	4-5.5	20-70	2.5-4.5	35
<i>E. quadrilinea</i> (44)	26.9±3.8 (20-33)	45.3±4.7 (31-51)	19.6±6.6 (8-29)			314±59 (250-500)	5.2±0.27 (3.5-6)	130.3±27.4 (3-200)	4±0.5 (2-5)	25.1±1.8 (23-30)
<i>E. rugulosa</i> (8)	10.6±1.2 (9-13)	19.3±5.2 (14-31)	13.6±3.6 (8-18)			325±55 (250-400)	5.3±0.24 (3.5-5.5)	162.5±28 (20-200)	3.9±0.4 (2.5-4.5)	28.1±4 (23-35)
<i>E. striata</i> (2)	30±4.2 (27-33)	48±13	21±7.1 (16-26)			325±35 (300-350)	5.5±0 (3.5-5.5)	132.5±10.6 (45-140)	3.5±0 (2.5-3.5)	25±0 25
<i>E. sublate</i> (1)	29±2	44±8	25±1			175	(5-6)	20-125	4.5-6	25
<i>E. unguis</i> (2)	25±4.2 (22-28)	39±6	18.5±0.7 (18-19)			-	-	145±7.1 (5-150)	5±0 (4-5)	-
<i>E. variegata</i> (2)	22.5±7.8 (17-28)	14.5±7.8 (9-20)	19±5.7 (15-23)			488±124 (400-575)	4.5±0 (3-4.6)	220±42.4 -250	3.5±0 (2.5-3.5)	32±8.5 (26-38)

CANNABIS PATHOGENS VIII: MISIDENTIFICATIONS
APPEARING IN THE LITERATURE

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Abstract:

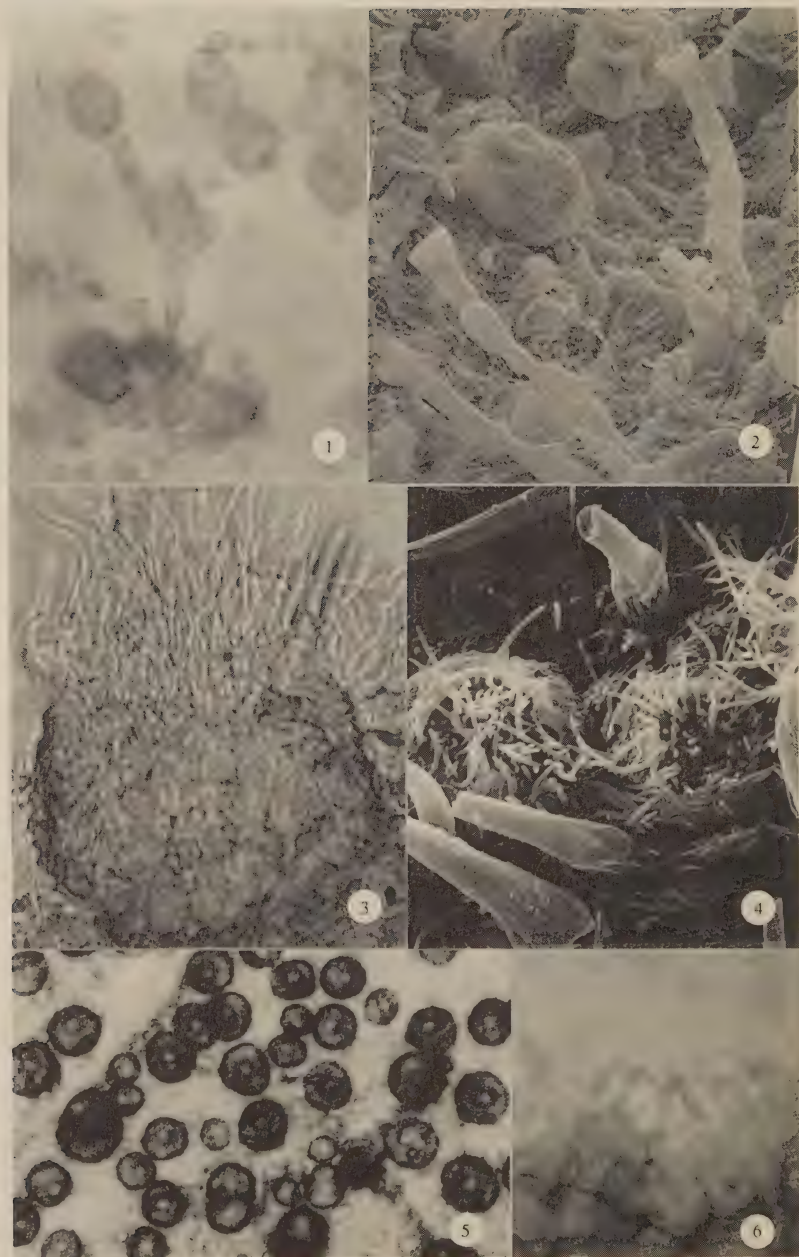
Voucher specimens reveal the following fungi are misidentifications: *Coniothecium* sp., *Cylindrosporium* sp., *Leptosphaerulina trifolii*, *Erysiphe communis* var. *urticirum*, *Dendrophoma marconii*, and *Phyllosticta cannabis*. Inconsistent exsiccati by Rabenhorst (*Ascochyta cannabis*, *Spilosphaeria cannabis*) and Briosi & Cavara (*Dendrophoma marconii*) probably represent substitutions. Voucher specimens could not be located for nine other fungi cited in the *Cannabis* literature: *Chaetomium graminis*, *Cladosporium resinae*, *Colletotricum lini*, *Diplodia maydis*, *Fusarium graminearum*, *Melampsora cannabis*, *Neocosmospora vasinfecta*, *Pythium debaryanum*, *Septoria graminum*; compelling arguments for these being misidentifications are presented. Three other fungi are cited on the wrong host plant (i.e., not on *Cannabis*): *Mycosphaerella superflua*, *Lasiodiplodia theobromae*, and *Volutella* sp.

Introduction:

Schultes *et al.* (1974) describes *Cannabis* as a "neglected taxon." Its pathogens have fared a similar fate; consequently, a monograph is needed (McPartland, 1992). A review of the literature reveals over 400 fungal taxa associated with *Cannabis* substrate. Many of these taxa represent taxonomic synonyms or misidentifications of fungi and/or their host. This paper investigates and reports 22 misidentifications.

Materials and Methods:

The literature was reviewed by: 1) searching AGRICOLA and other computer databases (keywords: *Cannabis*, hemp, disease); 2) reviewing host lists in Sylloge Fungorum, Petrak's Lists and Index of Fungi; 3) sorting data cards and unpublished studies stored at the National Fungus Collections and National Agriculture Library (Beltsville, MD); 3) scanning indices in mycological/phytopathological journals and texts (and expanding these scans by citation tracking) in university libraries associated with the following herbaria: CM, CUP, F, ICA, ILL, ILLS, IND, KANU, MICH, MCA, MSC, OS, OSC, PAC,



PUL, UCSC, UMO, UWSP, WIS, VT (also University of Chicago and University of Pittsburgh). Herbarium acronyms conform to Index Herbariorum (Holmgren *et al.*, 1990).

To locate mycologist's voucher specimens, I consulted the six-part "Collectors" series by Index Herbariorum (e.g., Lanjou & Stafleu, 1954). Additional information was obtained from the Hunt Institute for Botanical Documentation, Pittsburgh (courtesy of Anita L. Karg, Archivist). Common names of diseases follow those adopted by the American Phytopathological Society (McPartland, 1991).

Fruiting bodies in voucher specimens were dislodged from host tissue with dissecting needles and rehydrated in 3% KOH, then measured at their widest part. They were either hand-sectioned with a razor blade or teased apart with needles under a 4x objective. Material was stained with either cotton blue in lactic acid or 1% phloxine in water (phloxine subsequently replaced with water by capillary action under the cover slip). Curved spores were measured along their circumference, widths measured at their widest part, and means determined from 25 to 50 measurements. Materials were prepared for scanning electron microscopy as previously described (McPartland, 1984).

Results and Discussion:

Three exsiccati and five voucher specimens were examined. Their correct identifications are presented below, with details of their collection and a description of morphological characteristics:

'Coniothecium sp.'

Figs. 1 & 2.

This specimen of *Stemphylium botryosum* Wallroth 1833, was misidentified by G. Rada, from *C. sativa* leaves near Lima, Peru in June 1942, deposited at BPI.

Description: Conidiophores arise in clumps (often 10-15), straight or flexuous, simple or occasionally branched at their base, 1-7 septate, cylindrical except for swelling at apex, dilute olive brown except darkening at swollen apex, smooth except echinulate at apex, 4-6 μm wide swelling to 7-10 μm at apex, usually 25 to 85 μm long, but continued proliferation through 1-5 previously-formed apices may extend conidiophore length to 120 μm . Conidia initially oblong to subspherical, hyaline and verruculose; at maturity oblong to subdoliiform, densely echinulate, with 3 (sometimes 4) transverse septa and 2-3 (sometimes 4) complete or nearly complete longitudinal septa, with a single conspicuous constriction at the median transverse septum, dilute to deep olive brown, 30-35 x 20-25 μm .

Plate, facing page – Misidentified fungi on *Cannabis*: (1) *Stemphylium botryosum* misidentified as "*Coniothecium* sp.," LM, 990x; (2) *S. botryosum*, SEM, 600x; (3). *Septoria cannabina* misidentified as "*Cylindrosporium* sp.," LM, 990x; (4). *S. cannabina*, SEM, 600x; (5). *Phoma* species misidentified as "*Erysiphe communis* var. *urticirum*;" LM, 88x; (6). *Phoma* sp. conidia and conidiophores, LM, 1650x.

'Cylindrosporium sp.'

Figs. 3 & 4.

This misdetermination is actually *Septoria cannabina* Peck 1884 (non *S. cannabina* Westendorp 1857). It was collected by J.T. Rogers, from *C. sativa* leaves near Yarrow, Maryland, July 1917, deposited at BPI. It is the basis for the "*Cylindrosporium*" citation in Miller *et al.* (1960) and Farr *et al.* (1989).

Description: Conidiomata epiphyllous, gregarious, immersed, globose, eventually erumpent and nearly cupulate, 66 µm in diameter, peridium thin-walled textura angularis-globulosa, honey-brown near the ostiole to almost colorless at the base, ostiole irregular, 26 µm in diameter. Conidiogenous cells short ampulliform to lageniform, simple, hyaline, holoblastic, up to 8 µm long. Conidia hyaline, filiform, pointed at the apex with a truncate base, usually curved, 1-3 septate, 20-30 x 1.0-2.0 µm.

Ostioles in this mature specimen are much wider than most *S. cannabina* specimens previously examined by the author. These cupulate pycnidia could easily be confused for acervuli, as in *Cylindrosporium*. Peck's taxon is an obvious homonym of Westendorp's taxon. Homonyms are rejected by the International Code of Botanical Nomenclature (Greuter *et al.*, 1988). See McPartland (1994a) for comments regarding Peck's taxon.

'Leptosphaerulina trifolii '

Nair & Ponnappa (1974) report isolating this pathogen from leaves of *C. sativa* growing near Golagokarnnath, India. They deposited a voucher specimen at the Commonwealth Mycological Institute.

The identity of IMI #181331 is undetermined, but it is not *L. trifolii* (Rostrup) Petrak 1959. Their voucher consists of a dried agar plate covered by thick, white, felted mycelium, with a random scattering of small (<100 µm) globose fruiting bodies. This does not resemble a *L. trifolii* culture. *L. trifolii* mycelium is gray and rarely floccose; pseudothecia arise in concentric rings of black satellite colonies, radiating from the central inoculation point. All fruiting bodies in Nair & Ponnappa's specimen were immature, containing no spores, a *jungkultur*.

'Erysiphe communis var. urticirum West. 1854'

Figs. 5 & 6.

Westendorp (1854) describes this species, "...sur celles du chanvre, aux environs de Louvain." Papers accompanying the type (deposited at BR) indicate Westendorp provisionally named his discovery "*E. martii* Lev." [Léveillé 1851, *nomen rejiciendum*], before erecting *E. communis* var. *urticirum*. Sixty-six years later, Oudemans (1920) cited the taxon as "*Erysimum commune* Duby, i *Urticearum* West., Not. IV, p.6"—wrong spelling, wrong author citation, wrong page number.]

The type specimen consists of two pistillate flowering tops, covered by a fine white mildew-like meshwork. But the meshwork consists of elongate leaf trichomes and mite webbings. Dead spider mites abound, 140 years in repose. There is no powdery mildew. The fruiting bodies are ostiolated, a *Phoma* species (a few yellow leaf spots also contain *Septoria cannabidis*). For a complete description, see McPartland (1994b).

'*Mycosphaerella superflua*'

Lentz (1977) bases his report of *M. superflua* (Auerswald) Petrak 1940 from a Johannes Kunze exsiccatus (Fungi Sel. no. 258, 1879). Inspection of the exsiccatus, however, revealed the host to be nettles (*Urtica dioica* L.), not hemp.

M. superflua resembles *Didymella cannabis* (Winter) von Arx 1962. *Didymella* and *Mycosphaerella* species can be difficult to differentiate; in the 1800's, *D. cannabis* was called *M. cannabis*, and *M. superflua* was called *D. superflua*. The anamorph of *M. superflua* can be confused with another *Cannabis* pathogen, *Cylindrosporium cannabinum* Ibrahimov 1955.

'*Spilosphaeria cannabis*'

Rabenhorst effectively published *Spilosphaeria cannabis* in 1857 as exsiccatus no. 559 in Herbarium vivum mycologicum, Edition II. Exsiccata are publications containing actual fungal specimens, rather than printed descriptions and illustrations. All exsiccati must be identical; all the specimens become syntypes. Unfortunately, Rabenhorst's no. 559 at BPI is a different fungus than no. 559 at B. Even the labels are different (McPartland, 1994b). The B specimen contains a fungus identical to *Septoria cannabis* (Lasch) Saccardo 1884, whereas the BPI specimen is a mix of *Phoma* and *Septoria* spp.

'*Ascochyta cannabis*'

There is no separate type specimen of *A. cannabis* Lasch 1846 (B. Hein, pers. communication). It was distributed as exsiccatus no. 1509 in Rabenhorst's Klotzchii Herbarium vivum mycologicum, Edition I. Again, specimens at B and BPI are different. Steventon (1967) previously documented irregularities in Rabenhorst's series of exsiccati. When he ran out of certain fungi, Rabenhorst would substitute others under the same exsiccatus number. The exsiccatus deposited at B is probably original, that at BPI represents a substitution.

'*Dendrophoma marconii*' A

Petrak (1923) suggests that *D. marconii* Cavara 1888 is identical to *Diplodina cannabicola* Petrak 1923. Brandenburger (1986), following Petrak, synonymizes the two species. This is erroneous, the type specimens are quite different (!).

These researchers may have based their decisions on a *D. marconii* exsiccatus distributed by Briosi & Cavara, I Funghi Parassiti delle Piante Coltivate od Utili, No. 20). Exsiccatus No. 20 at BPI is an *Ascochyta* species (like *D. cannabicola*), unrelated to Cavara's type of *D. marconii*. Briosi & Cavara, like Rabenhorst, must have substituted fungi in their exsiccata.

***Dendrophoma marconii*' B**

Charles & Jenkins (1914) match a fungus they found in Virginia with *D. marconii*. Their fungus subsequently developed a teleomorph *in vitro*, which they named "*Botryosphaeria marconii* (Cav.) Charles & Jenkins 1914."

They did not designate a type, but among the seven specimens they deposited at BPI, none contains an anamorph resembling *D. marconii*. Charles

& Jenkins compounded their error nomenclaturally, by naming the teleomorph a *combo nov.* instead of a *sp. nov.* (see Article 59.6, Ex.3, Greuter *et al.*, 1988).

'*Phyllosticta cannabis*'

This taxon first appears as *P. cannabis* (Lasch) Spegazzini 1881. But Spegazzini failed to designate a basionym. Some mycologists believe Spegazzini meant Kirchner's taxon, not Lasch's; they call it *P. cannabis* (Kirchner) Spegazzini (see Saccardo, 1884; Voglino, 1913; Röder, 1937; Farr, 1973).

Over 20 collections of "*Ph. cannabis*" were examined from herb B and BPI; none proved to be a true *Phyllosticta* species (i.e., no conidial appendages). Most of these collections can be accommodated in the genus *Phoma* (rarely, *Ascochyta*). Misidentified specimens of *Coniothyrium*, *Leptodothiorella*, *Fusicoccum* and *Phomopsis* spp. also occurred (McPartland, 1994b).

Voucher specimens of thirteen other suspect fungi cited in the *Cannabis* literature could not be located. Reasons for questioning these identifications are discussed below:

'*Chaetomium graminis*'

Oudemans (1920) cites "*C. fieberi* Corda, synonym *C. graminis* Rabenhorst," an erroneous synonymy. According to Ames (1961), *C. graminis* Rabenhorst is a synonym of *C. fieberi* Fuckel 1869, not *C. fieberi* Corda 1837. *C. fieberi* Fuckel, in turn, is a synonym of *C. elatum* Kunze 1817. And *C. fieberi* Corda is considered a synonym of *C. globosum* Kunze 1817. *C. globosum* is the most common and widely distributed member of the genus.

'*Alternaria cheiranthi*'

Gzebenyuk (1984) reports isolating this fungus from 96.4% of hemp stems sampled near Kiev, USSR. He uses the old citation "*A. cheiranthi* (Fr.) Bolle," a taxon rejected fifty years ago. Excepting Gzebenyuk, *A. cheiranthi* (Libert) Bolle 1924 is only known to attack wallflowers (*Cheiranthus cheiri* L.) in England.

Three other *Alternaria* species are reported on *Cannabis*: *A. alternata* (Fries:Fries) Keissler 1912 [= *A. tenuis* C. G. Nees 1816-7], *A. solani* (Ellis & Martin) Sorauer 1896, and *A. longipes* (Ellis & Everhart) Mason 1928 (McPartland, 1991). Most likely, Gzebenyuk confused one of these fungi (probably *A. alternata*) with *A. cheiranthi*.

'*Cladosporium resinae*'

Gzebenyuk (1984) found a fungus on Soviet hemp he called *C. resinae* (Lindau) deVries 1955. Eleven years prior to his publication, *C. resinae* was transferred to a new genus, as *Hormoconis resinae* (Lindau) vonArx & deVries 1973. This fungus normally occurs on petroleum substrates, such as jet fuel and facial creams. It has not been reported from herbaceous plant material. Three other *Cladosporium* species occur on *Cannabis*: *C. herbarum* (Persoon:Fries) Link 1815, *C. cladosporioides* (Fresenius) deVries 1952, and *C. tenuissimum* Cooke 1877 (McPartland, 1991).

'Colletotrichum lini'

The anthracnose fungus *C. lini* (Westerdijk) Tochinali 1926 is a specific parasite of flax (*Linum usitatissimum* L.), and not known to occur on other plants. Gzebenyuk (1984) reports finding this fungus on hemp.

Two other *Colletotrichum* species attack *Cannabis* — *C. coccodes* (Wallroth) Hughes 1958 [= *C. atramentarium* (Berkeley & Broome) Taubenhause 1916] and *C. dematium* (Persoon) Grove 1918 (McPartland, 1991). Morphology of *C. lini* conidia falls between these two species; Gzebenyuk probably confused one or the other as *C. lini*.

'Coniothyrium tenue'

A last critique of Gzebenyuk's account: he cites a Poaceae pathogen on *Cannabis* — *C. tenue* Diedicke 1914, an homonym of *C. tenue* Bubák, also described in 1914. Saccardo (1931) makes reference to this identity crisis. *C. tenue* should be synonymized under *C. psammae* Oudemans 1901, which it resembles in morphology and host range [they both attack *Calamagrostis epigeios* (L.) Roth].

Gzebenyuk also cites *C. olivaceum* Bonorden 1870 on Soviet hemp. Höhnelt moved *C. olivaceum* to *Microsphaeropsis* in 1917; Gzebenyuk nevertheless uses the long-outdated name. *M. olivacea* has not previously been reported on *Cannabis*; he may have misdetermined *C. cannabinum* Curzi 1927, a *Coniothyrium* species common on *Cannabis*.

'Diplodia maydis'

Lentz (1977) describes *D. maydis* (Berkeley) Saccardo 1884 on *Cannabis*, via its synonym *Sphaeria zeae* Schweinitz 1832. He confused the 1832 taxon with *S. zeae* Schweinitz 1822, basionym of *Gibberella zeae* (Schweinitz) Petch 1936. *G. zeae* is a common pathogen of *Cannabis* (McPartland, 1991). *D. maydis*, conversely, has only been cited on hemp in Lentz's confused account.

S. zeae Schweinitz 1832 is a homonym, and the fungus is currently termed *Stenocarpella maydis* (Berkeley) Sutton 1980. Sutton (1980), however, neglected to cite *D. maydis* in his list of synonyms.

'Fusarium graminearum'

Wollenweber & Reinking (1935) cite *F. graminearum* Schwabe 1838 as the conidial state of the hemp pathogen *Gibberella saubinetii* (Montagne) Saccardo, 1879. It is not. *G. saubinetii* is a synonym of *G. cyanogena* (Desmazières) Saccardo 1883; its anamorph is *F. sulphureum* Schlechtendahl 1824. *F. graminearum* is the conidial state of *G. zeae* (Schweinitz:Fries) Petch 1936.

'Lasiodiplodia theobromae'

Lentz (1977) cites *L. theobromae* (Pat.) Griffon & Maublanc 1909 acting as a primary root pathogen in African hemp. Tracking his source citation (Wallace, 1930) reveals Wallace describing *L. theobromae* on *Agave sisalana* L., not *Cannabis*.

'*Melampsora cannabis*'

Rataj (1957) created this orthographic error in his review of a publication by Flachs (1936). Flachs discussed *Melanospora cannabis* Behrens 1891 (a hyphomycete, not a rust), cause of "red boot" on hemp stems.

'*Neocosmospora vasinfecta*'

In 1899, the bacteriologist E.F. Smith erroneously connected the teleomorph *Neocosmospora vasinfecta* with *Fusarium oxysporum* Schlechtendahl: Fries f.sp. *vasinfectum* (Atkinson) Snyder & Hansen 1940. The two species are not related.

F. o. f.sp. vasinfectum frequently causes *Cannabis* wilt (Demekhina, 1950; Dobrozrakova *et al.*, 1956; Rataj, 1957; Ceapoiu, 1958; Serzane, 1962; Czyzewska & Zaraycka, 1961). Ceapoiu (1958) cites *N. vasinfecta* on *Cannabis*, based on this enduring holomorphic misconception.

Note in 1962, Noviello & Snyder named the wilt fungus

F. o. f.sp. cannabis. They overlooked six earlier accounts of *F. o. f.sp. vasinfectum* on *Cannabis*, claiming, "...the wilt disease and its pathogen apparently have not been described." Their taxon, *F. o. f.sp. cannabis*, is probably a race of *F. o. f.sp. vasinfectum*.

'*Pythium debaryanum*'

Kirchner (1906), Flachs (1936), Schultz (1939) Rataj (1957), Serzane (1962), and Kirchner (1966) cite this fungus attacking European hemp. *P. debaryanum* Hesse 1874 is not a true species. Hesse did not work with a pure culture. His descriptions and measurements represent a mixture of fungi. According to Plaats-Niterink (1981), most "*P. debaryanum*" citations usually represent misidentifications of *P. ultimum* Trow 1901. *P. ultimum* has been described on hemp (McPartland, 1991).

'*Septoria graminum*'

Rataj (1957) cites this species on *Cannabis*. *S. graminum* Desmazières 1843 has only been reported from cereals. Moving to a dicot is improbable.

'*Volutella species*'

Cook (1981) cites this fungus causing "brown-rot" of hemp. But the source listed in her bibliography (Ghosh & George, 1953) concerns *Hibiscus cannabinus* L., not *Cannabis*.

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CANNABIS PATHOGENS IX: ANAMORPHS OF BOTRYOSPHAERIA SPP.

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ABSTRACT

Cannabis sativa L. is added to the host list of *Lasiodiplodia theobromae*. *Sphaeria cannabis* is synonymous with the anamorph of *Botryosphaeria obtusa*. The microconidial state of *B. obtusa* is described but unnamed. Two synanamorphs of *Botryosphaeria marconii* are named as new species — *Leptodothiorella marconii* and *Fusicoccum marconii*. The use and abuse of synanamorphs is discussed.

INTRODUCTION

While collecting and collating a list of *Cannabis* pathogens (McPartland 1991, 1992), anamorphs of three *Botryosphaeria* species were identified:

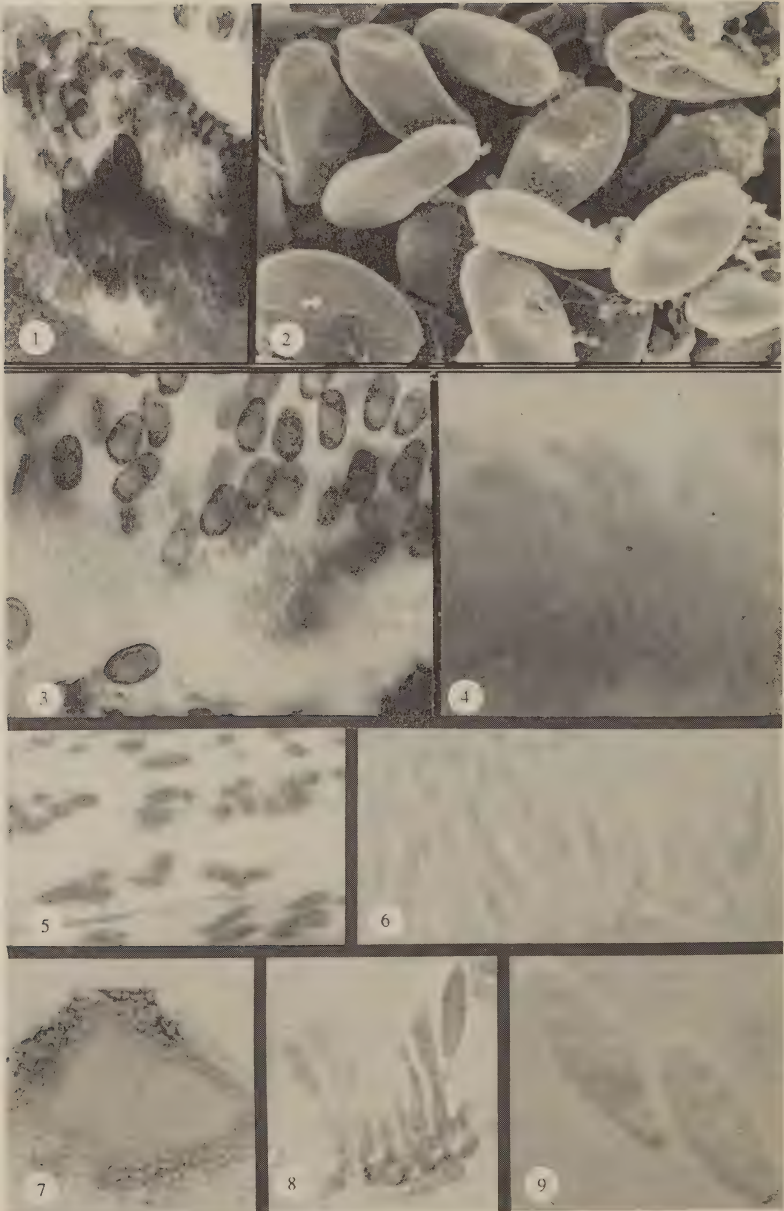
The first anamorph, *Lasiodiplodia theobromae* (Pat.) Griffon & Maublanc, has not heretofore been collected from *Cannabis*. Lentz (ca. 1977) cites it in his unpublished literature review (library, BPI). But tracking down Lentz's source (Wallace, 1930) reveals Wallace describing *L. theobromae* on *Agave sisalana* L., not *Cannabis*.

The second anamorph, *Sphaeria cannabis* Schweinitz, represents the earliest known identification of a *Cannabis* pathogen. Various authors date Schweinitz's publication between the years 1831 and 1834; Rogers (1944) presents strong evidence for the middle of the year 1832.

Two anamorphs are described from *Botryosphaeria marconii* Charles & Jenkins. Dewey (1914) discovered the pathogen in a Virginia hemp field, where the Pentagon now sits. Charles & Jenkins (1914) isolated the causal organism *in vitro*. They erroneously connected it with *Dendrophoma marconii* Cavara. The two fungi are not conspecific, nor congeneric.

MATERIALS AND METHODS

Conidiomata were dislodged from stems with dissecting needles and rehydrated in 3% KOH, then either hand-sectioned with a razor blade or teased apart with needles under a 4x objective. Material was stained with either cotton blue in lactic acid or 1% phloxine in water. Fifty conidia were randomly selected and measured, and ranges or means determined.



Specimens for SEM were fixed in 4% glutaraldehyde in 0.1 M cacodylate buffer, dehydrated in a graded ethanol series, critical-point dried with CO₂, sputter coated with gold palladium, and examined with an Amray 1200B SEM operating at 30kV.

Collections examined: From *Cannabis sativa* L. fiber varieties: *Lasiodiplodia theobromae*: UNITED STATES: Hanna City, Illinois, det: McPartland - 17.VIII. 1986. *Sphaeria cannabis*: HOLOTYPE. UNITED STATES: Salem, North Carolina, det: Schweinitz - undated (PH). ISOTYPE. UNITED STATES: Salem, North Carolina, det: Schweinitz - undated (FH). *Dendromphoma marconii*: HOLOTYPE. ITALY: Forli, det: Cavara - IX.1887 (PAV). ITALY: Forli et Pavia, det: Cavara - IX.1887 et VIII 1888, Briosi & Cavara'sl Funghi Parassiti delle Piante Coltivate od Utili no. 20 (BPI). ITALY: Pavia, det: Cavara - IX. 1888, Roumeguere's Fungi selecti exsiccati no. 5064, 1889 (BPI). *Botryosphaeria marconii*: NEOTYPE. UNITED STATES: Arlington Farm, Virginia, leg: Dewey, det: Charles - 12.IX.1923 (BPI). Arlington Farm, Virginia, leg: Dewey, det: Charles - 22.IX.1921 (BPI). Arlington Farms, Virginia, leg, det: Charles - 20.X.1921 (BPI). Arlington Farms, Virginia, leg: Charles & Cash, det: Charles - X.1921 (BPI). Arlington Farm, Virginia, leg: Dewey, det: Charles - 12.IX.1929 (BPI). Arlington Farms, Virginia, leg: Dewey, det: Charles - 12.X.1921 (BPI). Potomac Flats, D.C., leg: Patterson & Dyre, Det: Charles - 22.IX.1902 (BPI). *Diplodina cannabicola*: SYNTYPE. UKRAINE: Stryj (now Stry), det: Petrak - 1.IX.1917, Fungi polonici exsiccati no. 580 (BPI). Collections from other hosts: *Sphaeria obtusa*: HOLOTYPE. UNITED STATES: Bethlehem, Pennsylvania, on *Rubus* sp., det: Schweinitz - undated (PH). *Sphaeropsis visci*: HOLOTYPE. ITALY: Vogesis, on *Viscum album*, det: Saccardo - undated (PAD).

RESULTS & DISCUSSION

Botryosphaeria rhodina (Berkeley & Curtis in Curtis *apud* Cooke) von Arx, Genera of Fungi sporulating in pure culture: 143, 1970.

ANAMORPH: *Lasiodiplodia theobromae* (Patouillard) Griffon & Maublanc, Bull. trimest. Soc. mycol. France 25:57, 1909. Fig. 1

No teleomorph was observed in the field. **Conidiomata** stromatic, unilocular, carbonaceous black, peridium a thick-walled *textura angularis*, ostiolate, averaging 450 µm in diam. **Conidiogenous cells** hyaline, simple, cylindrical, sometimes septate, rarely branched, holoblastic, 5-15 x 3 µm. **Paraphyses** hyaline, cylindrical, septate, up to 50 µm long. **Conidia** ellipsoid, at first

Figs. 1-9: Anamorphs of *Botryosphaeria* spp.:

1: *Lasiodiplodia theobromae* conidia and conidiomatal wall, x685. 2: *Sphaeria cannabis* (type specimen), smooth and rough-walled conidia, SEM x1440. 3: *S. cannabis* (type specimen), conidiophores and conidia, x450. 4: *S. obtusa* (type specimen), microconidiophores and microconidia, x1300. 5: *Fusicoccum marconii* and *Leptodothiorella marconii* conidiomata on stems, x20. 6: *L. marconii* conidiogenous cells and microconidia, x1770. 7: *F. marconii* conidioma containing a locule of *L. marconii*, x235. 8: *F. marconii* conidiophores and conidia, x725. 9: *F. marconii* conidia, x1550.

hyaline and thin-walled, later developing a thick wall, median septum, dark brown pigmentation, longitudinal striations and a truncate base, 20-30 x 10-15 µm.

Lasiodiplodia theobromae (also known by its basionym, *Botryodiplodia theobromae* Patouillard) primarily infests mangos, bananas, avocados, melons, cacao pods, citrus fruits and cotton bolls. The *Cannabis* collection of *L. theobromae* corresponds with standard descriptions (e.g., Sutton, 1980).

Botryosphaeria obtusa (Schweinitz) Shoemaker, Canadian Journal of Botany 42:1298, 1964.

= *Sphaeria obtusa* Schweinitz, Trans Amer Philos Soc, New Series, 4:220, 1832.

SYNANAMORPH 1: *Sphaeropsis malorum* Peck, nomen nudum

= *Sphaeria cannabis* Schweinitz, Trans Amer Philos Soc, New Series, 4:222, 1832.

Figs. 2-3

Conidiomata immersed but at length erumpent, stromatic, solitary or gregarious, unilocular, globose, averaging 235 µm diameter. Outer wall black, carbonaceous, peridium *textura angularis-globulosa*, 30-40 µm thick; inner wall hyaline and thin. **Conidiogenous cells** arising from inner wall, hyaline, simple, cylindrical, holoblastic, discrete, determinate, 8-14 µm in length, 3-4 µm in width. **Macroconidia** borne in mucilage, elliptical or broadly clavate, base often truncate and bordered by a scar, thick-walled, verruculose or almost smooth-walled, at first hyaline and unicellular with a large central guttule; rapidly becoming brown, at length becoming 1-septate and biguttulate, averaging 19.9 x 10.6 µm.

Schweinitz collected *S. cannabis* from hemp stems near Salem, North Carolina. Eighty years later, Charles & Jenkins (1914) wrote, "[Schweinitz's] description is too meager to be of any taxonomic value... this species is of historical interest only..." No teleomorph was observed in Schweinitz's type of *S. cannabis*, contrary to Saccardo (1883) and Oudemans (1920), who label *S. cannabis* an ascomycete. Papers accompanying the FH isotype contain an undated description by M.A. Curtis, who annotates, "*Sphaeropsis*?"

Inspection of Schweinitz's *S. obtusa* type discloses an identical anamorph. I synonymize *S. cannabis* under the anamorph of *B. obtusa*. But this fungus has no name. For years it was called "*Sphaeropsis malorum* Peck," an error, since Peck never described *S. malorum* (Stevens, 1933; Shoemaker, 1964).

Concerning *S. cannabis*, Sutton writes (personal communication), "I would be doubtful that *Sphaeropsis* is correct..." He notes the *external* conidial ornamentation and *stromatic* conidiomata preclude *S. cannabis* from *Sphaeropsis*. The type species of *Sphaeropsis*, *S. visci* (Fries) Saccardo, appears pycnidial, rather than stromatic. But are these characteristics valid? Stevens (1933), who studied hundreds of *B. obtusa* specimens, observed, "Pycnidia on the smooth, thin bark of raspberry are small and unilocular, while those on currant are thicker walled and multilocular..." Miller (1928) concludes, "...there is no method known for differentiating an unilocular stroma from a true perithecium [or pycnidium]."

S. cannabis conidia examined with a scanning electron microscope (Fig. 2) reveal both smooth walls (like *S. visci*) and verruculose surfaces (like the type

species of *Aplosporella*, *apud* Sutton, 1980). Wang *et al.* (1985) examined *Sphaeropsis sapinea* (Fries) Dyko & Sutton and found conidia with both smooth walls and pitted walls. It seems wall ornamentation is not a workable species criterion, let alone a generic one.

Assigning a name to this synanamorph involves *Sphaeropsis*, *Aplosporella*, *Diplodia*, *Botryodiplodia*, *Macrodiplodia*, *Dothiorella*, *Cytosphaera*, *Pleosphaeropsis*, and alters taxonomy within *Botryosphaeria*. I will follow Shoemaker (1964) and Laundon (1973), who published accounts of the fungus but declined to name it.

B. obtusa

SYNANAMORPH 2: unnamed

Fig. 4

Conidiomata indistinguishable from those producing macroconidia. **Conidiophores** cylindrical, simple or branched at their base, hyaline, septate, 10-23 μm in length, 1.8-2.5 μm in width. **Conidiogenous cells** holothallic, integrated, indeterminate. **Microconidia** formed in basocatenate chains, hyaline, short cylindrical, truncate at each end, smooth walled, aseptate, with a large central guttule, 2-5 x 1.8-3.0 μm .

This microconidial synanamorph of *B. obtusa* is rarely seen. Dodge (1930) observed, "pycnidia of *Sphaeropsis malorum* occasionally discharge small elliptical hyaline spores along with the large brown spores which are characteristic of the species." Shear & Stevens (1924) describe and illustrate "Micropycnosporos... about 2-3 μ long, oblong, and have never been observed to germinate." Hesler (1916) described microconidia "budding" from hyphae. My observations of microconidia (Fig. 4) suggest a thallic ontogeny (highly unusual in anamorphs of *Botryosphaeria* and other Dothideales), perhaps a *Trullula* Cesati 1852. These discordant elements in Schweinitz's specimen may be mycoparasites. Observation of this spermatial state must be confirmed in culture.

Botryosphaeria marconii Charles & Jenkins, J Agricultural Res 3:83, 1914

SYNANAMORPH 1:

Fusicoccum marconii McP., *sp. nov.*

Fig.5, 7-9

Conidiomata multilocularia, globosa, immersa tum erumpens, 130-160 μm latitudine. Paries externus pallide brunneus, autem fuscans prope ostiolum, textura angularia-epidermoidea; paries internus hyalinus et tenuissimus. **Conidiophora** ex pariete interno orta, hyalina, laevia, simplicia vel ramosa et septata prope basim, 10-16 μm longitudine, usque ad 4.0 μm latitudine basi angustata ad 2.5-3.0 μm apice. **Cellulae conidiogenae** holoblasticae, integratae, determinatae. **Macroconidia** fusiformia, unicellularia, hyalina vel glauca, laevitunicata, basim frequenter truncata, 16-20 x 5-8 μm . In caulis languidis vel emortuis et siccatus Cannabis sativae, holotypus specimen a L.H. Dewey lecta, BPI 600713.

Conidiomata multilocular, globose, immersed then erumpent, 130-160 μm in diameter. Outer wall pale brown but darkening near the ostiole, *textura angularis-epidermoidea*; inner wall hyaline and very thin. **Conidiophores** arise from inner wall, hyaline, smooth, simple or branched and septate near the base, 10-16 μm long, up to 4.0 μm wide at the base tapering to 2.5-3.0 μm at the tip.

Conidiogenous cells holoblastic, integrated, determinate. **Macroconidia** fusiform, single-celled, hyaline to glaucous, smooth-walled, base truncate, 16-22 x 5-8 μm .

Holotype: BPI no. 600713, labeled *Botryosphaeria marconii*, USA: Virginia, Arlington Farms, leg: L.H. Dewey -12.IX.1923.

Conidiogenesis resembles the "holoblastic phialides" of *B. dothidia* (Mougeot-Fries) Cesati & de Notaris, as described by Maas & Uecker (1984). Charles & Jenkins (1914) described the macroconidial state as "...characteristic of the genus *Macrophoma* ..." but did not legitimize it with a binomial. Flachs (1936), Gitman & Boytchenko (1934) and Petri (1942) also observed this anamorph, albeit namelessly. In herbarium specimens it occurs much more frequently than its synanamorph, below.

B. marconii

SYNANAMORPH 2:

Leptodothiorella marconii McP., *sp. nov.*

Figs. 5-7

Fusicocco marconii affinis et similis sed cellulae conidiogenae enteroblasticae, phialidicae, 3-12 μm longitudinae x 1-3 μm latitudinae; microconidia ellipsoidea, 3.0-4.0 x 1.5-2.5 μm . Holotypus specimina a Patterson et Dyre lecta, BPI 600377.

Conidiomata indistinguishable from those of *F. marconii*. **Conidiogenous cells** simple or rarely branched, lageniform to cylindrical, 3-12 μm long, up to 3 μm wide at base tapering to 1 μm at apex, enteroblastic, phialidic, integrated or discrete, with minute channel. **Microconidia** ellipsoid, single-celled, hyaline, occasionally biguttulate and swollen towards each end, 3.0-4.0 x 1.5-2.5 μm . Holotype: BPI no. 600377, labeled *Botryosphaeria marconii*, USA: District of Columbia, Potomac Flats, leg: F.W. Patterson & M.P. Dyre - 22.X.1902.

According to Charles & Jenkins (1914), this morph arises first in culture, followed by macroconidia (sometimes within the same locule), and finally asci with ascospores. They considered the microconidial state identical to *Dendrophoma marconii* Cavara 1888. It is not. They compounded their error nomenclaturally, by naming the teleomorph a *combo nov.* instead of a *sp. nov.* (see Article 59.6, Ex.3, Greuter *et al.*, 1988).

Leptodothiorella Höhnelt, a small genus (ca. 14 named species), is often associated with *Phyllosticta* synanamorphs and *Guignardia* teleomorphs (Bissett & Palm, 1989). But it also has been applied to the spermatial state of *Botryosphaeria* species (Sutton, 1980; Van der Aa, 1973). *L. marconii* conidiogenesis is phialidic, agreeing with Sutton's concept of *Leptodothiorella* and contrary to van der Aa (who interprets *Leptodothiorella* spores as blastoconidia). Conidiogenous cells may elongate via percurrent proliferation, as Jensen (1983) illustrated in a *Diaporthe* anamorph.

Leptodothiorella species characteristically produce cylindrical to dumbbell-shaped conidia. Exceptions are described as oblong (e.g., *L. cyathea* Sydow), ellipsoidal (*L. cisti* Petrak, *L. advena* Sydow), even globose (*Guignardia arachidis* Punithalingham).

The term synanamorph seems to have originated with Hughes (1979). Applying several names to multiple synanamorphs within one holomorph has been debated. Gams (1982) states separate designations are only justified in

cases of dissimilar conidia with different conidiogenesis. Here I follow recommendation 59A of the Botanical Code (Greuter *et al.*, 1988).

No cultures of *B. marconii* are currently available. Charles & Jenkins (1914) studied the species *in vitro*, but neglected to mention cultural characteristics. Nor did they designate a type. Seven packets of *B. marconii* currently exist at BPI; No. 600713 contains an ascomycete closely resembling Charles & Jenkin's description of *B. marconii*, it is designated a neotype (not a lectotype, although Charles examined it).

Determining the relationship between *B. marconii* and *B. dothidea* awaits the study of cultures.

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I thank curators for loans of specimens from B, BPI, FH, PAV, PH.

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MIXTOCONIDIUM CANARIENSE, A NEW GENUS AND SPECIES OF LICHENICOLOUS COELOMYCETES WITH DIMORPHIC CONIDIA.

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ABSTRACT: A new genus and species of lichenicolous fungi is described, living on *Ramalina* species from the Canary Islands. It is characterized by small microconidia and large, 1-septate macroconidia mixed in the same conidioma. The *Ramalina* thallus forms a special tissue around the fungus conidiomata that resembles an apothecium with thalline border and black disk.

KEY WORDS: Lichenicolous coelomycetes, *Mixtoconidium*, *Ramalina*.

Mixtoconidium Etayo, gen. nov.

Conidiomata pycnidia, singularia vel aggregata, erumpescentia, subglobosa, atrobrunnea ad nigra, parietibus pseudoparenchymatis, cellulis brunneis et verrucosis. Cellulae conidiogenae acrogenae, subcylindricae vel obclavatae, holoblasticae, hyalinae. Macroconidia singularia, cylindrica vel allantoidea, hyalina, 1-septata, septo non constricta. Microconidia minoria, non septata et bacilliformia.

Mixtoconidium canariense Etayo, sp. nov.

Conidiomata 85-300 μm diam, in gallis 0.2-0.5 mm diam, immersa. Cellulae conidiogenae annellatae, 6-12 x 2-2.5 μm . Macroconidia 1-septata, 10-13 x 3.5-4(-5) μm . Microconidia non septata, 4-6.5 x 0.8-1 μm .

Typus: **Spain**, Canary Islands, Gran Canaria, Hacienda de Osorio, on *Ramalina canariensis*, on thin branches of *Quercus* sp., 4 December 1992, A. Pérez de Zabalza & A. Ariño, (IMI-holotypus; hb. Etayo 3470, hb. Diederich-isotypi)

(Fig. 1 & 2)

Conidiomata pycnidial, spherical, 0.085-0.3 mm diam, immersed in galls (0.2-0.5 mm diam) of the host very similar in appearance to apothecia with a black "disk" and a conspicuous "thalline margin"; the galls each contain one well-developed conidioma, and sometimes a few small less-developed conidiomata. Wall dark brown, composed of textura intricata, individual cells dark brown with a distinctively verrucose outer layer.

Macroconidial morph often predominating. *Conidiogenous cells* arising from the inner cells of the conidiomatal wall, holoblastic, percurrently proliferating with one or, more frequently, several annellations, discrete, hyaline, smooth, 6-12 x 2-2.5 μm . *Conidia* hyaline, medianly 1-septate, not or hardly constricted at the septum, apex obtuse, base truncate, thin-walled, smooth, straight or slightly curved, 10-13 x 3.5-4(-5) μm .

Microconidial morph mixed with the macroconidial morph. *Conidiogenous cells* similar to those of the macroconidial morph, straight or slightly curved, 9-11 x 2-2.5 μm . *Conidia* bacillar to subcylindrical, simple, hyaline, smooth, distinctly truncate at the base, straight or slightly curved, 4-6.5 x 0.8-1 μm .

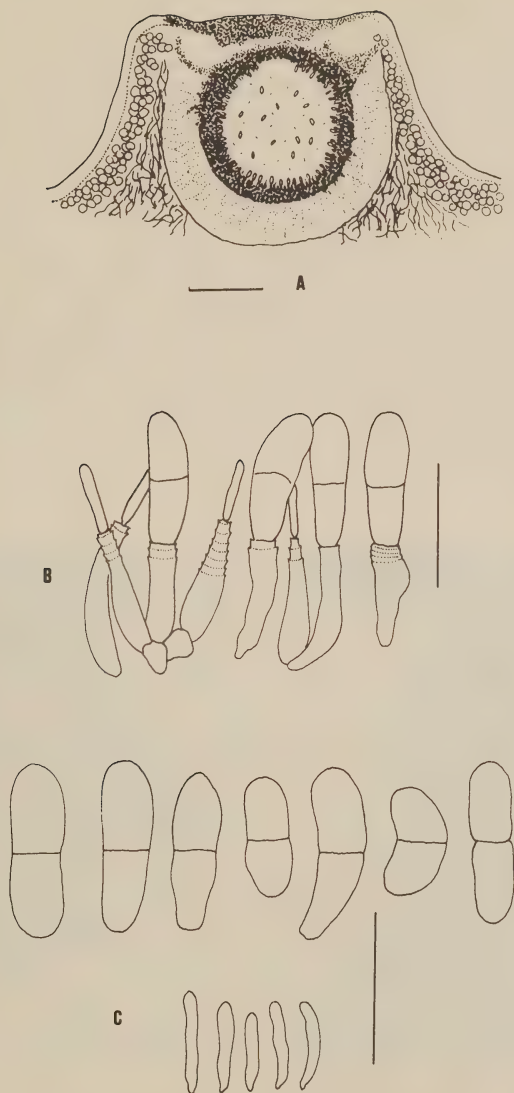


Fig. 1. *Mixtoconidium canariense* (hb. Etayo). **A**, section through a gall with one conidioma surrounded by a special prosoplectenchymatic, gelatinous and hyaline tissue; **B**, conidiogenous cells with macroconidia and microconidia; **C**, septate macroconidia and bacillar microconidia. Scales A, 100 μm ; B & C, 10 μm .

DISCUSSION

Macro- and microconidia are present and mixed within the same conidioma. This is unusual but not a particularly situation in fungi; it has been described recently in a species of lichenicolous fungi, *Stromatopogon baldwinii* Zahlbr. (Diederich, 1992), and in a species of lichen, *Lecanora schistina* (Etayo & Diederich, 1993).

The new genus has been compared with several other genera of Coelomycetes. The recently described lichenicolous species *Diplolaeviopsis ranula* (Giralt & Hawksworth, 1990), although with similar macroconidia differs in many features like conidiomatal structure, absence of galls, conidia of only one type, conidiogenous cells and host.

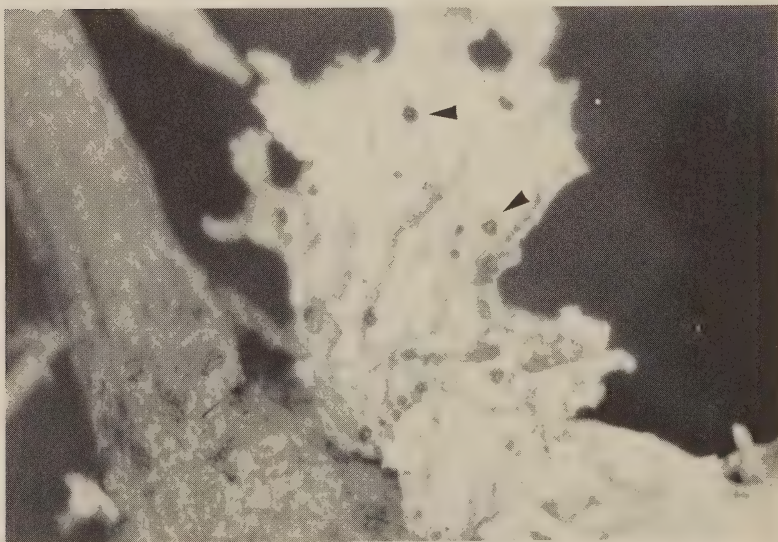


Fig. 2. *Mixtoconidium canariense* (holotypus), infected *Ramalina* thallus with galls resembling apothecia with black "disk" and "thalline margin".

In *Scaphidium* Clem. the stromatic conidiomatal wall is irregular in thickness and composed of *textura angularis*, the conidiomata are generally not spherical and there is only one type of conidium. The only known species is a pathogen on a grass. No galls are formed. In *Mixtoconidium* the conidiomatal wall is pycnidial, more regular and composed of *textura intricata*.

Inside the gall, the pycnidium is surrounded by a hyaline gelatinous prosoplectenchymatic tissue, 40-60 μm thick, composed of very thin hyphae probably belonging to the lichen, possibly formed as a reaction of the lichen to the infection by the parasite.

Finally, Vouaux (1914) described the supposed anamorph of *Celidium insidens* Vouaux (only macroconidia), possibly an *Arthonia* found on *Ramalina fraxinea* thallus in Tenerife. The conidia in this description seem close to those of *Mixtoconidium*. As *Arthonia* species never have this type of macroconidia, neither this type of conidiomata (Purvis & al., 1992), it is possible that Vouaux's samples belong to our new species.

Hosts: *Ramalina canariensis* and *R. duriaei* growing on *Quercus* sp.

Distribution: Known only from the Canary Islands.

Additional specimen: Spain, Gran Canaria, Hacienda de Osorio, on branches of *Quercus* sp., on *Ramalina duriaei*, 4 December 1992, A. Pérez de Zabalza & A. Ariño (hb. Etayo 3470).

I wish to thank Dr. A. Pérez de Zabalza and Dr. A. Ariño for giving me the *Ramalina* species on which the fungus has been discovered; Dr. Paul Diederich, Dr. D. L. Hawksworth and Dr. B. C. Sutton for valuable comments on the manuscript. I acknowledge a grant from D.G.C.Y.T. assigned to the project PB 89-0518-C02-01.

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A further note on *Byssonectria* (Pezizales)

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Noted below are additional comments and references related to my published study of the genus *Byssonectria* P. A. Karst. (Pfister 1993). I was unaware of two publications related to this study; these were pointed out to me by Nils Lundqvist and are summarized below. Under the name *Humaria aggregata* (Berk. & Br.) Sacc. (= *Byssonectria terrestris* (Alb. & Schw.) Pfister) Rosenberg (1933) reported on ascomatal development based on material from Sweden. My results confirmed his findings; he, however, noted the presence of an antheridium which I did not observe. He found that the antheridium was derived from the hyphae that ensheath the ascogonial branch. The antheridium fused with the terminal cell of the ascogonial branch. This cell he referred to as a trichogyne. In another account, Skuja (1943) described a new species of *Chlamydomonas* Ehrenberg growing in association with a fungus referred to as a species of *Pyronema* Carus which, as illustrated, is probably referable to *Byssonectria terrestris*. I had noted the presence of cyanobacteria in some collections that I studied. Skuja (1943) suggested that the relationship he studied should be considered a facultative symbiosis. Clearly more information is needed on the environmental and physiological requirements of this interesting species.

During a visit to the cryptogamic herbarium of the Rijksherbarium at Leiden (L) in the spring of 1994, I found material of *Thelebolus terrestris* Alb. & Schw. in the Persoon herbarium labeled as originating from Albertini and Schweinitz ("*communicatus ab ipsis auctoribus*"). The species epithet *terrestris* is the oldest one available among a series of names that have been used for the type species of the genus *Byssonectria*. I designated (Pfister 1993) a neotype specimen, from Germany in FH, under the assumption that no original Albertini and Schweinitz material was extant. The Leiden

specimen agrees with the protologue and with my circumscription of the species but there is no indication that this specimen was used by Albertini and Schweinitz in formulating their description of *T. terrestris*. Its status is thus one of being "authentic" at some level but it is not verifiably a holotype nor is there collection data present on the specimen that would allow it to be considered a lectotype. If it could be demonstrated that this material was studied by the authors when constructing their description, it would certainly be possible to overthrow my designated neotype. For the moment though the specimen has no official status. It does provide evidence that use of the name *terrestris* in *Byssonectria* is consistent with the intent of the describing authors. Subsequent interpretations of Albertini and Schweinitz's illustration account for the misapplication of this epithet.

Authors should be aware of the presence of Albertini and Schweinitz specimens in the Persoon herbarium. Workers often assume, as I did, that there is no extant Albertini and Schweinitz material. This is not the case, as my survey of the Persoon Herbarium indicated. Several specimens were found and traced to Albertini and Schweinitz. Judging by the range of specimens present in his herbarium, it is clear that Persoon maintained a lively and active interaction with his mycological peers, thus material from many early authors is present in his herbarium but is often overlooked.

Acknowledgements

Nils Lundqvist (S) provided me with information and comments, and J. van Brummelen (L) arranged the loan of the Albertini and Schweinitz specimen and graciously hosted me in Leiden.

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TAXONOMY OF PUCCINIA EREBIA ON CLERODENDRUM (VERBENACEAE)

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Clerodendrum is an important genus of the Angiospermic family Verbenaceae. The members of the family Verbenaceae and also Bignoniaceae are known to be parasitised by the species of Prospodium Arth. (Cummins, 1940; Cummins, 1959; Cummins & Hiratsuka, 1983).

Arthur (1907) erected the genus Prospodium with Prospodium appendiculatum (= Puccinia appendiculata Wint.) as its type species. Prospodium with nearly 50 species is an interesting genus and is characteristic in having type 7 spermagonia; uredinoid aecia; subepidermal or superstomatal usually with paraphysate uredinia, urediniospores simple or bilaminate; telia subepidermal or superstomatal or subcuticular, teliospores puccinioid, pedicillate, often possessing appendages on the pedicel. As per Cummins (1940, 1959) and Cummins & Hiratsuka (1983), all the species of Prospodium are geographically confined to the American continent only. One exception cited by Cummins (1940) was Uredo stereospermi Syd. which was reported from Ceylon and was listed along with species of Prospodium since it was parasitising Stereospermum a Bignoniaceous host and was possessing characteristic bilaminate, bicapitate urediniospores.

Puccinia erebia was erected by Sydow (1913) to accommodate a rust fungus parasitising Clerodendrum commersonii Spreng. (Verbenaceae). Sydow's creation of this new rust taxon was based on a collection made by E.D. Merrill from Manila, Philippines. The original description pertained to telial stage only. Recently during a study of the rust fungi parasitising Clerodendrum the authors have examined specimens of P. erebia including the type. A critical examination

of these specimens revealed the presence of uredinia in close association with telia. Urediniospores were echinulate with obscure germ pores. Though the teliospore description was similar to the one proposed by Sydow (1913) interestingly the authors found some structures at the base of the teliospore pedicels which were not clearly discernible under light microscope. For further elucidation of these structures a Scanning Electron Microscopic study was undertaken. SEM pictures revealed the presence of appendages on teliospore pedicels. The presence of appendages on the teliospore pedicel is a characteristic feature of the genus Prospodium and Clerodendrum being a Verbenaceous host, the rust taxon P. erebia is identified as a species of Prospodium. Therefore, the authors are proposing the necessary nomenclatural change. A description of the uredinia, urediniospores and the teliospore pedicel is given. A Scanning Electron Microscopic picture of the spore forms is also provided.

Prospodium erebiae (H.&P.Sydow) Bagyanarayana & John Ravinder comb. nov.

= Puccinia erebia H.&P. Sydow, Philipp. Journ. of Sci. 8 : 475. 1913.

Additive characteribus: Urediniis hyphophylliis, densus, subepidermalibus, plerumque erumpentis, raro non erumpentis, flavidis, maculis 1 mm diam., apapophysata; urediniosporiis 29 - 39 x 25 - 31 um, pyriformis, parietis 2 um crassa, echinulatis, poris germinativis obscuris.

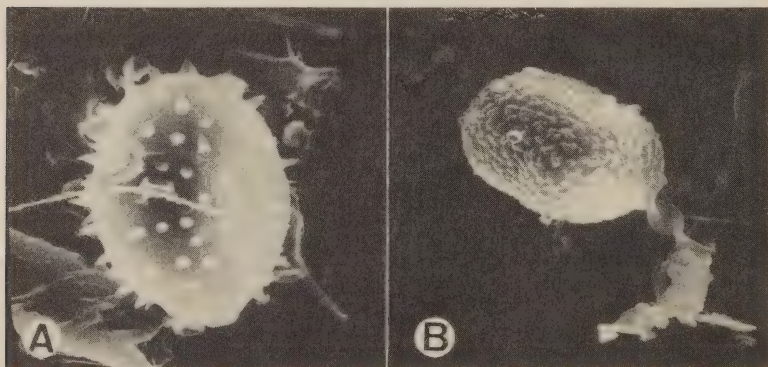


Fig. 1 Prospodium erebiae comb. nov. (A) Echinulate urediniospore, 3200X (B) Pedicellate teliospore with appendages, 2000X.

Teliosporiis pedicillatis, persistenti, basae pedicello tuberculatis.

Holotypus: Puccinia erebia Syd. In foliis Clerodendri commersonii (Lam.) Spreng., Manila, Philippines, 22 Feb. 1913, E.D. Merrill, E. Bartholomew Herb. Sydow, Fungi Exsiccati 335. Herb. F.H.

Specimens examined : Clerodendrum minahassae T. & B., Porac Pampanya Prov., Luzon, Philippines, 30 October 1923, M. I. Clemens, F. Petrak Pilzherbarium No. 4564, Herb. B.; Cagayan Prov., Luzon, Philippines, Mary Strong Clemens, Jan. 1924, Herb. F.H.

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APHYLLOPHORALES (BASIDIOMYCETES) FROM CENTRAL SIBERIA

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Abstract. A thorough investigation of wood-inhabiting Aphyllophorales was undertaken within a limited area in Central Siberia. Altogether, 361 species are recorded, mainly from forests dominated by *Abies sibirica* Ledeb. The forest region is seriously affected by human activities like industrial pollution and cutting.

The flora of wood-inhabiting basidiomycetes (Aphyllophorales) have been studied in taiga-forests in Central Siberia. Almost 3000 specimens, representing 361 species from the families Coniophoraceae, Corticiaceae, Hymenochaetaceae, Lachnocladiaceae, Polyporaceae, and Thelephoraceae were collected during the years 1988 - 1991. The study area is located in E. parts of the Novosibirsk region, 54,5°N, 85°E. This part of the taiga forest is under serious pressure from human activities like industrial pollution and forest cutting. Collecting took place in herb- and fern-rich *Abies* forests, in other coniferous forests with *Larix sibirica* Ledeb., *Pinus sylvestris* L., and in broad-leaved forests with *Populus tremula* L. and *Betula pendula* Roth.

The localities investigated is situated at the foothills of the Altai Mountains. During the last glaciation period, this area was not covered with ice. The continuity of coniferous forests is certainly very long here, and the area can be looked upon as a hypothetical centre of redispersal of vegetation in Siberia, after the last glaciation period (Kryloff, 1961). Climatically, the area is characterized by a vegetation period of 160 days, and precipitation between 500 - 850 mm per year. Earlier reports on wood-fungi from central Siberia are found in Killermann (1943), where scattered records from various parts of the area are reported. In the present contribution, the wood-fungus flora has been investigated, based on extensive collecting for several years within a limited area.

In the list of species (below) the wooden substrate is given when possible. Thereafter, the frequency is expressed in words (common - occasional - rare) or the number of findings is given, in brackets. Nomenclature follows mainly Hjortstam (1987), Ryvarden (1991), and Larsen (1974). The specimens are deposited in the private herbarium of the author and with numerous duplicates in GB.

List of species

CORTICIACEAE

- Aleurodiscus amorphus** (Pers.:Fr.) Schroet. - On *Abies* (common).
A. cerrusatus (Bres.) Höhn. & Litsch. - On *Salix* (1).
A. lividoo caeruleus (P. Karst.) Lemke - On twigs and wood of *Abies* (3).
Amphinema byssoides (Pers.:Fr.) John Erikss. - (1).
Amylocorticium canadense (Burt) John Erikss. & Weresub in Weresub - On *Abies* (1).
Amylosporomyces subasperisporus (Litsch.) Hjortstam & Ryvarden - On twigs of *Abies* (3).
Amylostereum chailletii (Pers.:Fr.) Boidin - On coniferous wood (common).
Athelia bombacina (Pers.) Jülich - On *Larix*, *Abies*, *Salix* (occasional).
A. epiphylla Pers. - On *Larix*, *Abies*, *Salix* (occasional).
Athelopsis laceratum (Litsch.) John Erikss. & Ryvarden - On *Abies* (1).
Auriculariopsis ampa (Lev.) Maire - On *Populus* (common).
Basidioradulum radula (Fr.:Fr.) Nobles - (2).
Boidinia furfuracea (Bres.) Stalpers & Hjortstam - On *Abies* (4).
Botryobasidium subcoronatum (Höhn. & Litsch.) Donk - (rare).
B. candicans John Erikss. - (occasional).
B. conspersum John Erikss. - (2).
B. aureum Parm. (common).
Botryohypochnus isabellinus (Fr.) John Erikss. - (common).
Brevicellicium olivascens (Bres.) K.H. Larss. & Hjortstam - (4).
Byssocorticium pulchrum (S. Lundell) M.P. Christ. - (1).
Byssomerulius corium (Fr.) Parm. - On deciduous wood (rare).
Ceraceomyces borealis (Romell) John Erikss. & Ryvarden - (rare).
C. serpens (Fr.) Ginns - (common).
C. sublaevis (Bres.) Jülich - (2).
C. sulphurinus (P. Karst.) John Erikss. & Ryvarden - (2).
C. tessulatus (Cooke) Jülich - (1).
Cerocorticium notabile (Jacks.) Jülich & Stalpers - (rare).
Chaetoporellus latitans (Bourd. & Galz.) Bondartsev & Singer - (common).
Chondrostereum purpureum (Pers.:Fr.) Pouzar - (occasional).
Clavulicium macounii (Burt) John Erikss. & Boidin ex Parm. - On *Abies* (1).
C. delectabile (H.S. Jacks.) Hjortstam - (3).
Corticium roseum Pers. - On *Salix*, *Populus* (common).
C. erikssonii Jülich - On *Populus* (2).
Cristinia gallica (Pilát) Jülich - (1).
C. helvetica (Pers.) Parm. - (occasional).
Crustoderma dryinum (Berk. & M.A. Curtis) Parm. - (common).
Crustomyces expallens (Bres.) Hjortstam - On *Abies*, *Sorbus*, *Populus* (common).
C. subabruptus (Bourd. & Galz.) Jülich - (occasional).
Cylindrobasidium evolvens (Fr.:Fr.) Jülich - On *Betula*, *Padus*, *Populus* (common), on bark of *Abies*, *Larix* (occasional).
Cystostereum murrarii (Berk. & M.A. Curtis) Pouzar - (5).
Cytidia salicina (Fr.) Burt - (2).
Dendrocorticium polygonoides (P. Karst.) M.J. Larsen & Gilb. - On *Padus*, *Populus* (rare).
Erythricium laetum (P. Karst.) John Erikss. & Hjortstam - (1).

- Fibriciellum silvae-ryae** John Erikss. & Ryvarden - On *Populus* (1).
Fibulomyces mutabilis (Bres.) Jülich - (2).
F. septentrionalis (John Erikss.) Jülich - (common).
Flavophlebia sulfureo-isabellina (Litsch.) K.H.Larss. & Hjortstam - On bark of *Abies* (1).
Galzinia incrustans (Höhn. & Litsch.) Parm. - (2).
Gloeocystidiellum convolvens (P.Karst.) Donk - (common).
G. karstenii (Bourd. & Galz.) Donk - On bark of *Populus* (3).
G. leucoxanthum (Bres.) Boidin - On twigs of *Salix* (common).
G. ochraceum (Fr.:Fr.) Donk - On *Abies* (2).
G. porosum (Berk. & M.A.Curtis) Donk - On *Salix, Padus* (3).
Gloeoporus taxicola (Pers.:Fr.)Gilb. & Ryvarden - On coniferous wood (2).
Gloiothele lactescens (Berk.) Hjortstam - On *Salix* (1).
Hyphoderma argillaceum (Bres.) Donk - (occasional).
H. clavigerum (Bres.) Donk - (1).
H. definitum (H.S.Jacks.) Donk - (3).
H. guttuliferum (P.Karst.) Donk - (2).
H. mutatum (Peck) Donk - (occasional).
H. obtusum John Erikss. - (rare).
H. pallidum (Bres.) Donk - (1).
H. praetermissum (P.Karst.) John Erikss. & Å.Strid - (occasional).
H. puberum (Fr.) Wallr. - (1).
H. roseocremeum (Bres.) Donk - (4).
H. setigerum (Fr.) Donk - (common).
Hyphodontia abieticola (Bourd. & Galz.) John Erikss. - (1).
H. alienata (S.Lundell) John Erikss. - On *Salix, Populus* (rare).
H. alutaria (Burt) John Erikss. - On *Populus* (1).
H. arguta (Fr.) John Erikss. - (occasional).
H. aspera (Fr.) John Erikss. - (2).
H. barba-jovis (Bull.:Fr.) John Erikss. - (4).
H. breviseta (P.Karst.) John Erikss. - On *Abies* (occasional).
H. crustosa (Pers.:Fr.) John Erikss. - (common).
H. detritica (Bourd.)John Erikss. - (4).
H. floccosa (Bourd. & Galz.) John Erikss. - (3).
H. pallidula (Bres.) John Erikss. - (common).
H. pilaeocystidiata (S.Lundell) John Erikss. - On *Abies* (1).
H. pruni (Lasch) Svrcek - On *Padus* (2).
H. sambuci (Pers.) John Erikss. - (common).
H. spathulata (Schrad.:Fr.) Parm. - On *Abies, Populus, Sorbus* (common).
H. subalutacea (P.Karst.) John Erikss. - On *Salix* (1).
Hyphodontiella multiseptata Å.Strid - (1).
Hypochnicium polonense (Bres.) Å.Strid - On (5).
H. lundellii (Bourd.)John Erikss. - On *Abies* (1).
H. bombycinum (Sommerf.:Fr.)John Erikss. - (occasional).
H. erikssonii Hallenb. & Hjortstam - (1).
H. eichleri (Bres.)John Erikss. & Ryvarden - (1).
Hypochnopsis mustialanensis (P.Karst.) P.Karst. - (1).
Intextomyces contiguus (P.Karst.)John Erikss. & Ryvarden - On coniferous and deciduous wood (common).

- Irpex lacteus** (Fr.:Fr.)Fr. - (occasional).
Kavinia albobiridis (Morgan)Gilb. & Budington - (1).
Laxitextum bicolor (Pers.:Fr.) Lentz - On *Padus*, *Betula* (3).
Laurilia sulcata (Burt) Pouzar - On *Larix* (common).
Leptosporomyces fuscostratus (Burt) Hjortstam - (common).
L. galzinii (Bourd.) Jülich - (common).
L. ovoideus Jülich - (1).
L. roseus Jülich - (2).
Melzericium udicolum (Bourd.)Hauerslev - On *Padus*, *Salix* (3).
Metulodontia nivea (P.Karst.)Parm. - (common).
Mycoacia aurea (Fr.) John Erikss. & Ryvarden - (4).
M. fuscoatra (Fr.:Fr.) Donk - On *Betula* (occasional).
M. uda (Fr.) Donk - (1). Hymenium greenish when live.
Mycoaciella bispora (Stalpers) John Erikss. & Ryvarden - On *Populus* (1).
Peniophora cinerea (Pers.:Fr.)Cooke - On *Caragana*, *Padus*, *Sorbus* (common).
P. incarnata (Pers.:Fr.)P. Karst. - (1).
P. limitata (Chaillat:Fr.)Cooke - On deciduous wood (common).
P. nuda (Fr.)Bres. - On deciduous wood (3).
P. piceae (Pers.)John Erikss. - On coniferous wood (occasional).
P. pini (Schleich.:Fr.)Boidin - On *Pinus* (2).
P. polygonia (Pers.:Fr.)Bourd. & Galz. - On *Populus* (common).
P. rufa (Pers.:Fr.)Boidin - On *Populus* (occasional).
P. versicolor (Bres.)Sacc. & Syd. - On *Padus*, *Populus* (3).
P. violacea-livida (Sommerf.)Massee - On deciduous wood (occasional).
Phanerochaete tuberculata (P.Karst.)Parm. - (2).
P. filamentosa (Berk. & M.A.Curtis)Burds. - (2).
P. velutina (DC.:Fr.)P. Karst. - (common).
P. raduloides John Erikss. & Ryvarden - (2).
P. omnivora (Shear)Burds. & Nakasone - On twigs of *Abies* (1).
P. calotricha (P.Karst.)John Erikss. & Ryvarden - (3).
P. sordida (P.Karst.)John Erikss. & Ryvarden - (common).
P. laevis (Burt)Parm. - (common).
Phlebia tremellosus (Schrad.:Fr.) Burds. & Nakasone - (common).
Phlebia centrifuga P. Karst. - On *Abies* (occasional).
P. griseo-flavescens (Litsch.) John Erikss. & Hjortstam - On twigs of *Abies* (rare).
P. lilascens (Bourd.) John Erikss. & Hjortstam - (1).
P. livida (Pers.:Fr.) Bres. - (3).
P. martiana (Berk. & M.A.Curtis) Parm. - On *Populus* (1).
P. nitidula (P.Karst.) Ryvarden - (1).
P. radiata Fr. - (common).
P. rufa (Fr.) M.P.Christ. - On *Sorbus* (3).
P. serialis (Fr.) Donk - On *Populus*, *Sorbus* (2).
P. subserialis (Bourd. & Galz.) Donk - On *Abies* (1).
P. unica (H.S.Jacks. & Dearden) Ginns - (1).
Phlebiella christiansenii (Parm.) K.H.Larss. & Hjortstam - (1).
P. fibrillosa (Hallenb.) K.H.Larss. & Hjortstam - (2).
P. pseudotsugae (Burt) K.H.Larss. & Hjortstam - (common).
P. romellii (Hjortstam) K.H.Larss. & Hjortstam - (1).
P. vaga (Fr.) P.Karst. - (common).

- Phlebiopsis gigantea** (Fr.:Fr.) Jülich - On coniferous wood (1).
Piloderma byssinum (P.Karst.) Jülich - (common).
P. croceum John Erikss. & Hjortstam - (common).
P. lanatum (Jülich) John Erikss. & Hjortstam - (2).
P. lanatum var. **bisporum** (Parm.) John Erikss. & Hjortstam - (1).
Plicaturopsis crispa (Pers.:Fr.) Reid - (common).
Punctularia strigosozonata (Schw.) Talbot - On *Salix* (2).
Radulomyces confluens (Fr.:Fr.) M.P.Christ. - (common).
Resinicium bicolor (Alb. & Schw.:Fr.) Parm - On coniferous wood (common).
R. furfuraceum (Bres.) Parm. - On coniferous wood (common).
Scopuloides rimosa (Cooke) Jülich - (common).
Scytinostroma galactinum (Fr.) Donk - (rare). Only collected during wet periods.
S. odoratum (Fr.) Donk - (2).
Scytinostromella heterogenea (Bourd. & Galz.) Parm. - (common).
S. nannfeldtii (John Erikss.) G.W.Freeman & R.H.Petersen - (1).
Sistotrema alboluteum (Bourd. & Galz.) Bond. & Sing. - (1).
S. brinkmannii (Bres.) John Erikss. - (common).
S. confluens Fr. - On decayed wood of *Abies* (1).
S. diademiferum (Bourd. & Galz.) Donk - (1).
S. muscicola (Pers.) S.Lundell in S.Lundell & Nannfeldt - (3).
S. oblongisporum M.P.Christ. & Hauerslev - (occasional).
S. octosporum (Schroet. ex Höhn. & Litsch.) Hallenb. - (1).
S. raduloides (Karst.) Donk - (1).
S. resinicystidium Hallenb. - On *Populus* (2).
Sistotrema sp. - Fruitbody smooth, athelioid, white to yellowish; basidia 3.5-4 x 8-10-
 (12) μm , with 4-6 sterigmata; basidia and subhymenial hyphae with oilish-refractive
 protoplasm; hyphae with clamps, subhymenial richly branched 1.5-2 μm , thin-walled,
 basal ones 2-4(5) μm , straight, with sparse branches and with thickened to thick walls;
 spores 2.5-3 x 1.5-2 μm , ovoid, with thickened walls and apiculus, and often clinging
 together in groups of 2 or more. Associated with brown rot; On *Abies* (1).
Sistotremastrum suecicum Litsch. ex John Erikss. - (1).
Sphaerobasidium minutum (John Erikss.) Oberw. in Jülich - (1).
Steccherinum ochraceum (Pers.:Fr.) S.F.Gray - (common).
S. laeticolor (Berk. & M.A.Curtis) Banker - (1).
S. ciliolatum (Berk. & M.A.Curtis) Gilb. & Budington - (common).
S. fimbriatum (Pers.:Fr.) John Erikss. - (common).
S. oreophilum Lindsey & Gilb. - On *Padus* (1).
S. muraschinskyi (Burt) Maas Geest. - On *Betula* (2).
Stereum sanguinolentum (Alb. & Schwein.:Fr.) Fr. - On coniferous wood (occasional).
Stereum hirsutum (Willd.:Fr.) S.F.Gray - On deciduous wood (rare).
S. subtomentosum Pouzar - On deciduous wood (occasional).
Subulicystidium longisporum (Pat.) Parm. - (common).
Trechispora alnicola (Bourd. & Galz.) Liberta - (2).
T. cohaerens (Schw.) Jülich & Stalpers - (2).
T. farinacea (Pers.:Fr.) Liberta - (1).
T. invisitata (H.S.Jacks.) Liberta - (1).
T. microspora (P.Karst.) Liberta - (occasional).
T. mollusca (Pers.:Fr.) Liberta - (common).
T. stellulata (Bourd. & Galz.) Liberta - (2).

- T. subsphaerospora** (Litsch.)Liberta - (2).
Tubulicrinis borealis John Erikss. - (2).
T. calothrix (Pat.)Donk - (occasional).
T. confusus K.H.Larss. & Hjortstam - On *Abies* (1).
T. hamatus (H.S.Jacks.)Donk - of *Salix* (1).
T. subulatus (Bourd. & Galz.)Donk - (occasional).
Uthatobasidium fusisporum (Schroet.)Donk - (common).
Vesiculomyces citrinus (Pers.) Hagström - (common).
Vuilleminia cystidiata Parm. - On *Populus* (1).

CONIOPHORACEAE

- Coniophora olivacea** (Fr.:Fr.)P.Karst. - (common).
Coniophora puteana (Schum.:Fr.)P.Karst. - (common).
Leucogyrophana mollusca (Fr.)Pouzar - (common).
L. sororia (Burt)Ginns - (1).
Pseudomerulius aureus (Fr.)Jülich - On coniferous wood (4).
Serpula himantioides (Fr.:Fr.)P.Karst. - On coniferous wood (1).

THELEPHORACEAE

- Pseudotomentella tristis** (P.Karst.)M.J.Larsen - (2).
Tomentella albomarginata (Bourd. & Galz.)M.J.Larsen - (occasional).
T. asperula (P.Karst.)Höhn. & Litsch. - (1).
T. brevispina (Bourd. & Galz.)M.J.Larsen - (common).
T. bryophila (Pers.)M.J.Larsen - (common).
T. chlorina (Masse)G. Cunn. - (occasional).
T. coerulea (Bres.)Höhn. & Litsch. - (occasional).
T. crinalis (Fr.)M.J.Larsen - (rare).
T. duemmeri (Wakef.)M.J.Larsen - (1).
T. epigaea (Burt)M.J.Larsen - (1).
T. ferruginea (Pers.:Fr.)Pat. - (common).
T. fuscoferruginosa (Bres.)Litsch. - (3).
T. galzinii Bourd. - (occasional).
T. griseo-umbrina Litsch. in S.Lundell & Nannf. - (2).
T. lateritia Pat. - (common).
T. molybdaea Bourd. & Galz. - (3).
T. neobourdotii M.J.Larsen - (rare).
T. ochracea (Sacc.)M.J.Larsen - (rare).
T. pilatii Litsch. - (1).
T. pilosa (Burt)Bourd. & Galz. - (common).
T. puberula Bourd. & Galz. - (occasional).
T. radiosa (P.Karst.)Rick - (3).
T. rhodophaea Höhn. & Litsch. - (rare).
T. rubiginosa (Bres.)Maire - (occasional).
T. ruttneri Litsch. - (rare).
T. subalpina M.J.Larsen - (4).
T. subcinerascens Litsch. (4).
T. subclavigera Litsch. - (5).
T. sublilacina (Ellis & Holw.)Wakef. - (occasional).
T. subtestacea (Bourd. & Galz.)Svrcek - (common).

- T. umbrinospora** M.J.Larsen - (2).
T. violaceofusca (Sacc.)M.J.Larsen - (2).
T. viridescens (Bres. & Torrend)Bourd. & Galz. - (1).
T. viridula (Bourd. & Galz.)Svrcek - (rare).
Tomentellastrum badium (Link)M.J.Larsen - (1).
T. caesiocinereum Svrcek - (2).
T. fuscocinereum (Pers.:Fr.)Svrcek - (occasional).
T. litschaueri (Svrcek)M.J.Larsen - (1).
Tomentellina fibrosa (Berk. & M.A.Curtis)M.J.Larsen - (2).
Tomentellopsis echinospora (Ellis)Hjortstam - (1).
T. pusilla Hjortstam - On twigs of *Larix* (3).

DICHOSTEREACEAE

- Asterostroma cervicolor** (Berk. & M.A.Curtis)Masse - (occasional).
Dichostereum boreale Pouzar - On coniferous wood (2).
Vararia investiens (Schwein.)P.Karst. - (3).
V. ochroleuca (Bourd. & Galz.)Donk - (1).

HYMENOCHAETACEAE

- Hymenochaete cinnamomea** (Pers.)Quel. - (occasional).
H. corrugata Fr.:Fr. - (1).
H. cruenta (Pers.:Fr.)Donk - On *Abies* (common).
H. fuliginosa (Pers.)Bres. - On coniferous wood (rare).
H. tabacina (Sowerby:Fr.)Lev. - (common).
Inonotus radiatus (Fr.)P. Karst. - On *Padus* (occasional).
I. rheades (Pers.)P.Karst. - (rare).
I. tomentosus (Fr.)Teng - (1).
Phellinus conchatus (Fr.)Quel. - (3).
P. ferrugineo-fuscus (P.Karst.)Bourd. & Galz. - On coniferous wood (1).
P. hartigii (Allesch. & Schnabl)Bondartsev - On coniferous wood (common).
P. igniarius (L.:Fr.)Quel. - (occasional).
P. laevigatus (Fr.)Bourd. & Galz. - (1).
P. nigrolimitatus (Romell)Bourd. & Galz. - (occasional).
P. pini (Brot.:Fr.)A.Ames - On *Larix* (common).
P. punctatus (Fr.)Pilát - (common).
P. tremulae (Bondartsev)Bondartsev & Borissov - (common).
P. viticola (Schwein.:Fr.)Donk - (occasional).
P. weirii (Murill)Gilb. - (occasional).

POLYPORACEAE

- Anomoporia bombycina** (Fr.)Pouzar - (1).
Antrodia albida (Fr.)Donk - (common).
A. lindbladii (Berk.)Ryvarden - (occasional).
A. oleracea (R.W.Davidson & Lombard)Ryvarden - On *Populus* (occasional).
A. plicata Niemelä - (1).
A. serialis (Fr.)Donk - (rare).
A. sinuosa (Fr.)P.Karst. - (rare).
A. xantha (Fr.)Ryvarden - (occasional).
Antrodiella hoehnelii (Bres.)Niemelä - (2).

- A. overholtsii** Ryvarden & Gilb. - (1).
A. romellii (Donk)Niemelä - (3).
A. semisupina (Berk. & M.A.Curtis) - (common).
Bjerkandera adusta (Willd.:Fr.)P. Karst. - (common).
Ceriporia excelsa (S.Lundell)Parm. - (1).
C. purpurea (Fr.)Donk - (common).
C. tarda (Berk.)Ginns - (occasional).
C. viridans (Berk. & Broome)Donk - (common).
Ceriporiopsis aneirinus (Sommerf.:Fr.)Domanski - (occasional).
C. gilvescens (Bres.)Domanski - (1).
C. resinascent (Romell)Domanski - (rare).
Cerrena unicolor (Bull.:Fr.)Murill - (rare).
Daedaleopsis confragosa (Bolton:Fr.)J.Schröt. - (common).
Datronia mollis (Sommerf.:Fr.)Donk - (occasional).
D. stereoides (Fr.)Ryvarden - (rare).
Diplomitoporus crustulinus (Bres.)Domanski - (common).
Fomes fomentarius (L.:Fr.)Fr. - (common).
Fomitopsis pinicola (Schwein.:Fr.)P.Karst. - (occasional).
F. rosea (Alb. & Schwein.:Fr.)P. Karst. - (occasional).
Gloeophyllum abietinum (Bull.:Fr.)P.Karst. - (occasional).
G. protractum (Fr.)Imazeki - (2).
G. sepiarium (Wolf.:Fr.)P.Karst. - (occasional).
Gloeoporus dichrous (Fr.)Bres. - (occasional).
G. pannocinctus (Romell)John Erikss. - (common).
Hapalopilus nidulans (Fr.)P.Karst. - (common).
Haploporus odoratus (Sommerf.:Fr.)Singer - (1).
Heterobasidion annosum (Fr.)Bref. - (common).
Ischnoderma benzoinum (Wahlenb.:Fr.)P.Karst. - (common).
Junghuhnia collabens (Fr.)Ryvarden - (occasional).
J. nitida (Fr.)Ryvarden - (2).
Laetiporus sulphureus (Bull.:Fr.)Murill - (rare).
Lenzites betulina (L.:Fr.)Fr. - (occasional).
Leptoporus mollis (Pers.:Fr.)Pilat - (3).
Osteina obducta (Berk.)Donk - (1).
Oxyporus corticola (Fr.)Ryvarden - (occasional).
O. populinus (Schumach.:Fr.)Donk - (1).
O. ravidus (Fr.)Bondartsev & Singer - (1).
Pachykytospora tuberculosa (Fr.)Kotl. & Pouzar - On *Padus* (4).
Parmastomyces transmutans (Overh.)Ryvarden & Gilb. - (occasional).
Perenniporia medulla-panis (Fr.)Donk - On *Abies*, *Padus*, *Sorbus* (common).
P. narymica (Pilat)Pouzar - On *Populus* (1).
P. subacida (Peck)Donk - (1).
Phaeolus schweinitzii (Fr.)Pat. - (rare).
Physisporinus vitreus (Pers.:Fr.)P.Karst. - (occasional).
Piptoporus betulinus (Bull.:Fr.)P.Karst. - On *Betula* (common).
Polyporus badius (Pers.:S.F.Gray)Schwein. - (occasional).
P. brumalis Fr. - (rare).
P. melanopus Fr. - (occasional).
Porpomyces mucidus (Pers.:Fr.)Jülich - (occasional).

- Postia caesia** (Schrad.:Fr.)P. Karst. - On coniferous wood (common).
P. balsamea (Peck)Jülich - (occasional).
P. floriformis (Quel.)Jülich - (occasional).
P. fragilis (Fr.)Jülich - (occasional).
P. leucomallela (Murill)Jülich - (2).
P. placenta (Fr.)Larsen & Lombard - On *Larix* (1).
P. sericeomollis (Romell)Jülich - (common).
P. stiptica (Pers.:Fr.)Jülich - (common).
P. subcaesia (David)Jülich - (common).
P. tephroleuca (Fr.)Jülich - (occasional).
P. undosa (Peck)Jülich - (occasional).
Pycnoporellus fulgens (Fr.)Donk - On coniferous wood (4).
Rigidoporus nigrescens (Bres.)Donk - On *Abies* (occasional).
Schizopora flavipora (Cooke)Ryvarden - (common).
Skeletocutis amorpha (Fr.)Kotl. & Pouzar - (1).
S. carneogrisea David - (2).
S. lenis (P.Karst.)Niemelä - (occasional).
S. nivea (Jungh.)Keller - (occasional).
S. odora (Sacc.)Ginns - (occasional).
Trametes cervina (Schwein.)Bres. - (3).
T. gibbosa (Pers.:Fr.)Fr. - (common).
T. hirsuta (Wulfen:Fr.)Pilat - (occasional).
T. ochracea (Pers.)Gilb. & Ryvarden - (occasional).
T. pubescens (Schumach.:Fr.)Pilat - (occasional).
T. suaveolens (Fr.)Fr. - (rare).
T. trogii Berk. - (occasional).
T. versicolor (L.:Fr.)Pilat - (occasional).
Trichaptum abietinum (Dicks.:Fr.)Ryvarden - (common).
T. biforme (Fr.)Ryvarden - (rare).
Tyromyces chioneus (Fr.) - P.Karst. (2).

Acknowledgement

I would like to thank prof. E. Parmasto, Tartu, for kind help with identification of species, and for giving me the possibility to fulfil part of my work at the Institute for Zoology and Botany, Tartu. I also want to thank dr. Nils Hallenberg, Göteborg, for identification of some specimens, for updating the nomenclature, and technical improvements of the manuscript.

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The genus *Polydesmia* in Spain

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Abstract

Three species of *Polydesmia* are described from Spain, one of them, *Polydesmia turbinata* Raitv. & R. Galán as new for science.

Introduction

Polydesmia Boud. is a small genus characterized by externally downy to tomentose apothecia having a pruinose hymenium. Korf (1978) added two species *P. dumontii* (Korf) Korf and *P. fruticola* Korf to this so far monotypic genus. We now add a fourth species, *P. turbinata* Raitv. & Galán. and discuss the distribution of the genus in Spain.

Taxonomy

A KEY TO THE KNOWN SPECIES OF POLYDESMIA

1. Apothecia yellowish, turbinate, asci 8-spored, 70–80 x 9–13 μm . Spores at maturity 3-septate, 18–24 x 2.5–4 μm

— *P. turbinata*

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21 Vanemuise St., Tartu EE2400, Estonia.

- Apothecia pure white to dirty white, cupulate to patellate.....2
- 2. Asci 8-spored, 80–110 x 8–11 μm . Spores at maturity 3-septate, 14–22 x 3.7–5.1 μm . Paraphyses apically strongly branched — *P. pruinosa*
- Asci and spores shorter. Paraphyses apically sparsely branched.....3
- 3. Asci 4-spored, 45–56 x 7.2–8.5 μm . Spores at maturity 1–3-septate, 9–13.5 x 2.2–2.7 μm — *P. dumontii*
- Asci 8-spored, 48–60 x 4.5–6 μm . Spores at maturity 1-septate, rarely 2–3-septate, 6–12 x 1.5–2.5 μm — *P. fructicola*

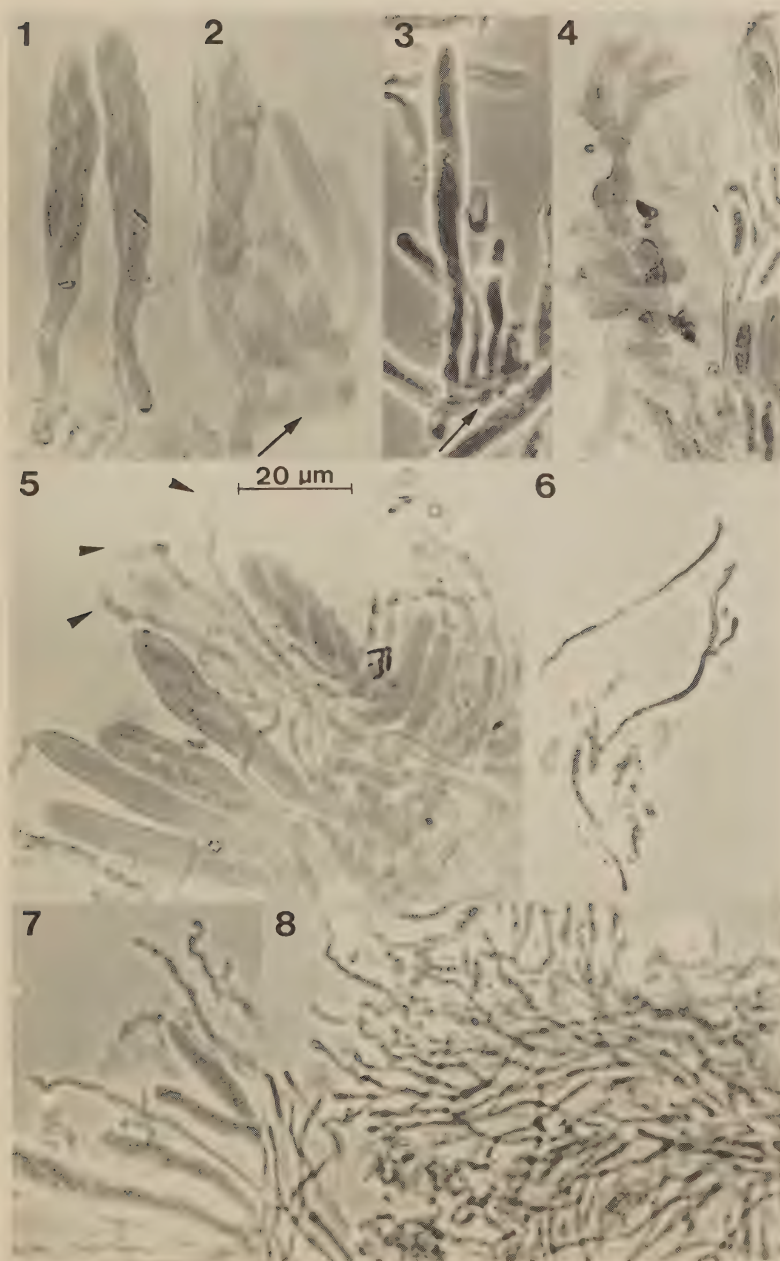
Polydesmia fructicola Korf, Mycotaxon 7: 475. 1978.

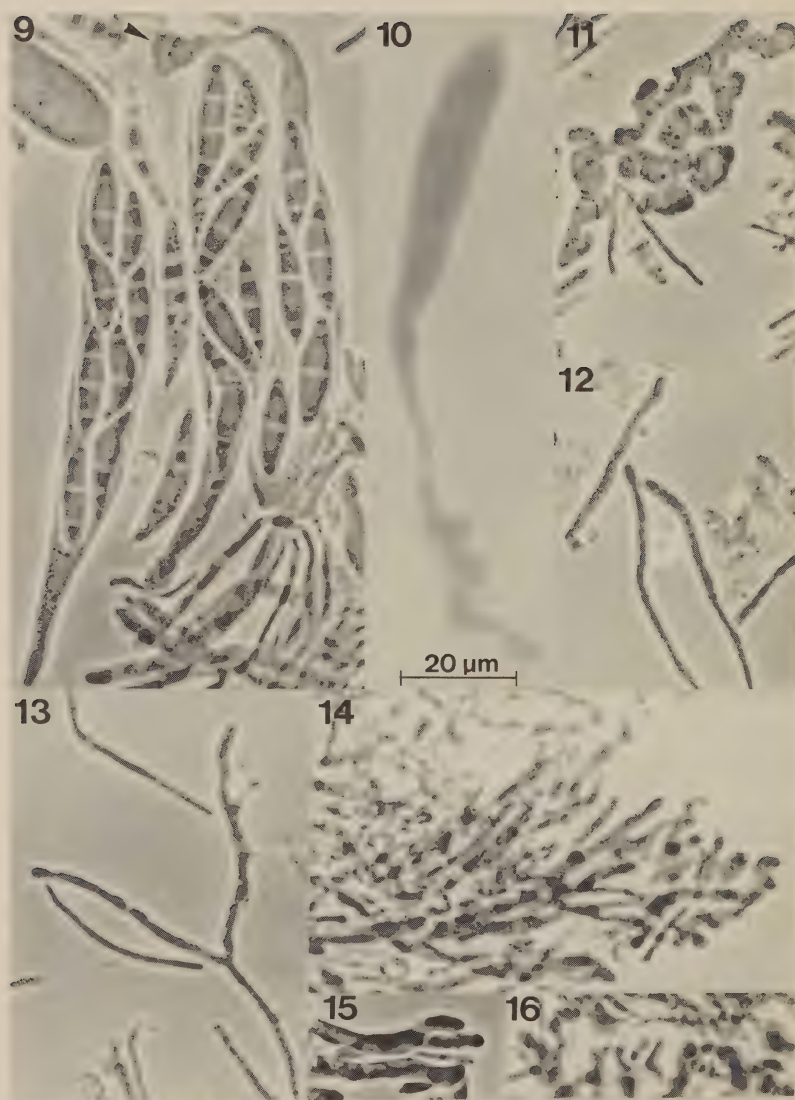
Figs. 1–8, 17

Apothecia scattered to gregarious, appearing sessile but really shortly stipitate, seated on a white inconspicuous subiculum. Disc slightly concave to plane 0.2–0.6 mm in diam., dirty whitish with a greenish tint when fresh, slightly pruinose. Receptacle cup-shaped, shining snow-white when fresh, white when dry, externally downy, with a wide downy margin. Ectal excipulum of textura angularis. Hairs hyaline, hyphoid, undulating, interwoven to spirally coiled, 4–5.5 μm diam. Asci arising from croziers, cylindrical to cylindric-clavate, 8-spored, apical pore blue in MLZ, 48–60 x 4.5–6 μm . Spores inequilaterally ellipsoid to allantoid, quite often sigmoid, usually 1-septate, 6–12 x 1.5–2.5 μm . Paraphyses filiform, undulating, apically nodulose to slightly branching, covered by loosely attached hyaline granules of amorphous matter which become easily detached in microscopic mounts, 1.5–2 μm diam.

Specimens examined: on fallen fruit-capsules of *Eucalyptus globulus*, Narga, Pontevedra, Spain, 19.11.1988, J. T. Palmer (RG-6864); on fallen stromatized leaves of *Rosa* sp. Arroyo de

Figs. 1–8. *Polydesmia fructicola*. **1.** Asci with spores. **2.** Asci originating from a ascogenous hypha. **3.** Ascogenous hypha with a group of young asci. **4.** Ascogenous hyphae (left) and ascospores (right). **5.** Hymenium (paraphyses indicated by arrows). **6 & 7.** Paraphyses. **8.** Excipular hairs.



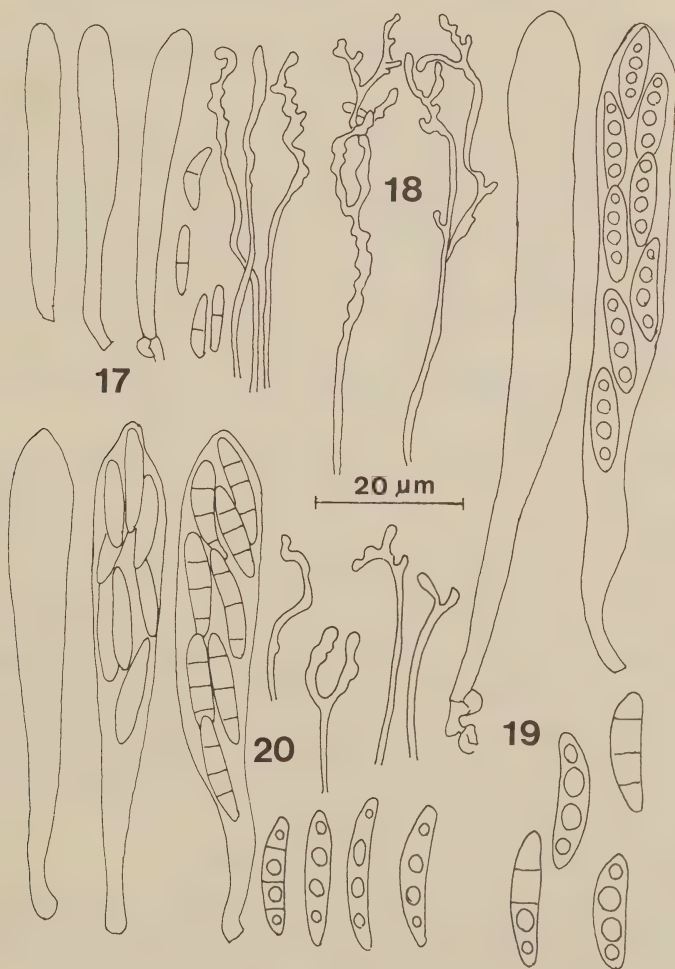


Figs 9 – 16. *Polydesmia turbinata*. 9. Asci with spores (basal croziers indicated by arrows). 10. Ascus originating from ascogenous hypha. 11. Ascogenous hyphae. 12 & 13. Paraphyses. 14 – 16. Excipular hairs.

Fig. 17. *Polydesmia fruticicola*: asci, spores, paraphyses. **Fig. 18.** *P. pruinosa*, paraphyses. **Fig. 19.** *P. pruinosa*, asci and ascospores. **Fig. 20.** *P. turbinata*, asci, paraphyses and spores.

las Gargantillas, Alía, Cáceres, 24.03.1994, R. Galán & A. Raitviir (RG-6870).

Korf (1978) has listed several localities from the Canary Islands and Madeira. The known distribution of this species is therefore now extended to the Iberian Peninsula. It seems to be a forest debris species and in both of our collections the substrate was stromatinized by some other fungus.



Polydesmia pruinosa (Jerdon) Boud., Bull. Soc. Mycol. France 1: 113. 1885.

Figs. 18–19.

This well-known species is widely distributed in Spain being more frequent in the northern areas. The distribution map (Fig. 21) summarizes our knowledge of it.

Polydesmia turbinata Raitv. & R. Galán sp. nova

Figs. 9–16, 20

Apothecia gregaria, breviter stipitata, turbinata, 0.3 mm in diametro, pallide lutea, hymenio vivide luteo. Asci clavati, uncinati, octospori, poro iodo coerulescentia, 70–80 x 9–13 μm . Sporae fusoideae vel allantoideae, primo quadriguttulatae, dein 1–3-septatae, 18–24 x 2.5–4 μm . Paraphyses propoloideae.

Ab *Polydesmia pruinosa* ascis brevis, sporis longis e colore luteo differt.

Holotypus: in capsula Eucalypti globuli, Narga, Pontevedra, Hispania, 19.11.1988, J. T. Palmer legit (RG-6865).

Apothecia gregarious but not confluent, shortly stipitate. Disc plane, bright yellow, up 0.3 mm diam. Receptacle turbinate, externally pale yellow, pruinose, with a quite narrow margin. Ectal excipulum composed of small-celled textura prismatica, cells hyaline, thin-walled, 7–10 x 2.5–5 μm , externally densely covered by a layer of interwoven flexuous to coiled hyphoid hyaline thin-walled hairs 2–3 μm diam. Asci clavate, arising from croziers, 8-spored, apical pore blue in MLZ, 70–80 x 9–13 μm . Spores fusoid, inequilateral to allantoid, containing 4 prominent oil globules, becoming 1–3-septate, 18–24 x 2.5–4 μm . Paraphyses with the upper one third twisted, nodulose, sometimes apically forked, 1.5–2.5 μm diam.

Etymology: referring to the ascocarp shape.

Specimen examined: on a fallen stromatized fruit-capsule of *Eucalyptus globulus*, Narga, Pontevedra, Spain, 19.11.1988, J. T. Palmer (Holotype RG-6865).

for the financial assistance of the Research Project PB91-0165: "Estudio de los hongos que fructifican en Espacios Naturales de Extremadura (Las Villuercas, Cáceres)".

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AMANITA POPULIPHILA—A NEW SPECIES
FROM THE CENTRAL UNITED STATES

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Summary

Amanita populiphila is described as new based on collections from Idaho, Kansas, Michigan, Minnesota, Montana, New Mexico, and Wyoming. All collections for which habitat information was recorded were made in association with *Populus*.

Methods and terminology follow those of Tulloss *et al.* (1992) and Tulloss (1993; 1994). With one exception (RET—Tulloss' personal herbarium), abbreviations of names of herbaria follow Holmgren *et al.* (1990). Collections for which no herbarium is cited are deposited in RET. Color codes of the form "5A2" are taken from Kornerup & Wanscher (1978). Color names in italics with first letters capitalized are from Ridgway (1912); for these colors, translation to Munsell notation is provided according to Hamly (1949).

Amanita populiphila (Fig. 1) is a medium sized mushroom assignable to *Amanita* section *Vaginatae* (Fr.) Quél. It can occur in large quantities under aspen and cottonwood in the central United States from the Mississippi River west into the Rocky Mountains. It is white to pallid at first, tending to take on tan or brown tones with age. Its stipe is exannulate and has an easily lost, cupulate, submembranous, white volva at its base. Rather thick warts may be left on both pileus and stipe. The species is edible.

Amanita populiphila Tulloss & E. Moses *sp. nov.*

Etymology: *Populus* + *-philo-*, loving; hence, *Populus*-loving because of association with that genus.

Pileus 30 - 120 (-135) mm *latus, initio albus vel subalbidus vel subalutaceus (disco plus minusve brunneore) deinde subflavidus vel alutaceus vel brunneus, convexus umbone lato deinde plano-convexus, carne nivea, margine striata et non appendiculata, velo universali detersili subalbido vel flavo-brunneo (ubi veto) et fragmenta parva vel verrucas formans. Lamellae liberae vel annexae, confertae, albae; lamel-*



D. C. Tulloss del. [from photos of E. Moses (a) & L. Fansler (b)]

Fig. 1 *Amanita populiphila* habit [a (Tulloss 8-11/13-90-EM1) $\times 0.5\pm$; b (holotype) $\times 2\pm$].

lulae truncatae. Stipes 63 - 175 (-220) $\times$ (5-) 7 - 20 mm, *albus, exannulatus, velo universali albo vel flavo-brunneo (ubi veto) membranaceo vel submembranaceo et fragmenta vel verrucas vel volvam cupulatum vel saccatum et laxe affixam ad basim stiptis maturi formans. Sporae* (7.0-) 9.2 - 12.5 (-21) $\times$ (6.0-) 8.2 - 11.2 (-15.8) μm . *Fibulae praesentes. Habitat saepe abundanter Populo in udis vel in sylvis sparsis. Holotypus:* U.S.A., Kansas, Pottawatomie Co., N of Manhattan, Tuttle Creek St. Pk., River Pond Area, W. R. & E. Moses *s.n.* [Tulloss 5-15-92-EM1] (NY).

PILEUS: 30 - 120 (-135) mm wide, white to off-white to *Tilleul Buff* (7.5YR 8.4/2.0), very pale tan (slightly darker over disc) or pale cream (with orange-brown tint over disc), often becoming yellowish (*e.g.*, more cream than 5A2 with margin remaining nearly white) to straw-color to tan to brown with age and handling, tacky to subviscid to viscid (Smith 50210), shiny to dull, broadly campanulate, then convex and broadly umbonate, then plano-convex, in age with margin uplifted; *context* pure white, unchanging when bruised or cut, 5 - 12.5 mm thick at stipe, thinning evenly for up to four-fifths of radius, then a membrane to margin; *margin* rather short striate at least at first (0.15 $\pm$ R), eventually with longer striation (0.2 - 0.4R) particularly in dry weather, frequently becoming rimose, nonappendiculate; *universal veil* absent or in often rather thick warts or small patches or a large areolate patch (Smith 84263), submembranous, fragile, deterrent, off-white to avellaneous at first, unchanging or becoming yellowish brown or yellowish buff to pale brown to grayish brown to "very dark" (Trueblood 5472) in age or through drying or handling.

LAMELLAE: free to adnexed, sometimes with long decurrent very pale orangish white lines on upper stipe, close to crowded, off-white to pinkish white to very pale orangish or pinkish cream in mass, cream to pale cream to sordid pale cream to white in side view, unchanging when cut or bruised, pale pinkish or salmon pink (Trueblood 5472) or pale orange to pale yellow-orange when just dried, 3 - 7.5 mm broad, with concolorous to very pale orangish white flocculence on edge; *lamellulae* truncate to excavate-truncate, in several ranks, unevenly distributed, common to plentiful.

STIPE: 63 - 175 (-220) $\times$ (5-) 7 - 20 mm, white, sometimes with pale watery streaks, not discoloring or becoming watery pale brown over time or from handling, narrowing upward to subcylindric, flaring slightly or not at all at apex, decorated in upper half with very pale orangish white flocculence, finely striatulate; *context* white to off-white (with watery streaks), usually unchanging when cut or bruised, sometimes sordid in lower stipe or pale tan in universal veil below stipe base, concolorous in larva tunnels, stuffed in whole or part with white cottony fibrils, becoming hollow, with central cylinder 2.5 - 14 mm wide; *exannulate; universal veil* as "thimble-like" cupulate volva, submembranous to membranous, thin to 3.5 mm or more thick, white, changing with age and drying as on pileus or taking on orange-red or brown spots in lowest portion, easily detached from stipe in mature specimens, frequently also as warts (separate or confluent) unevenly distributed along stipe or in rings around stipe and having form like that of warts on pileus.

Odor none (Smith 50210) or mild and pleasantly fungoid or pungent (Smith

84263) in older specimen. *Taste* mild and pleasantly fungoid in all parts except universal veil (tasteless). *EDIBLE* (with caution) and good with exception of unavoidably gritty universal veil.

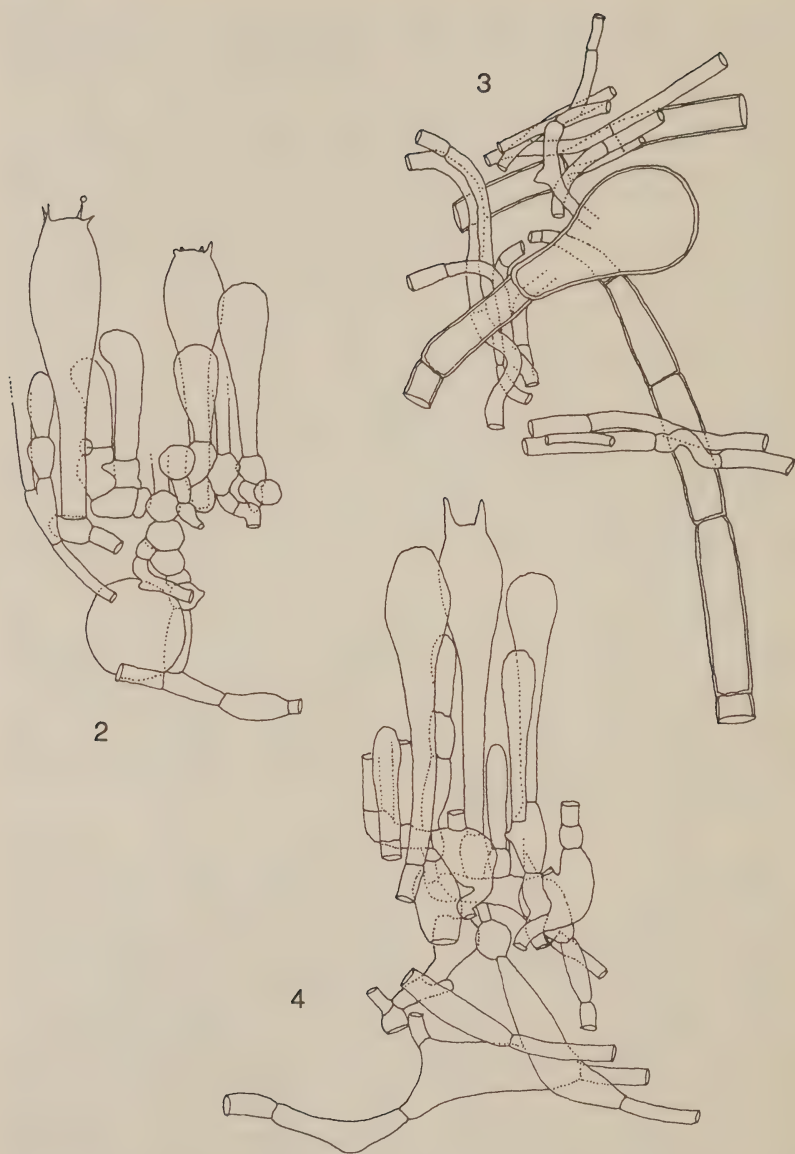
MACROCHEMICAL TESTS: Paracresol spot test for tyrosinase - for freshly collected material, rapidly positive throughout basidiocarp in specimens of all stages of development; in material collected 26 hours before testing, reaction took 5 min. Syringaldazine spot test for laccase - negative throughout basidiocarp with exception of exterior surface of undried portions of universal veil at stipe base and there rather rapidly and strongly positive (reddish lavender instantly or in less than 1 min., deepening to near ruby red). 95% ethanol (control for syringaldazine test) - negative in all parts. KOH - negative on pileus and lamellae. NH_4OH - very pale yellow on context throughout basidiocarp. Chemical tests performed on holotype and Moses 1.

PILEIPELLIS: with rather extensively gelatinized suprapellis colorless and 15 - 45 μm thick, with ungelatinized subpellis yellowish and 135 - 200 μm thick; filamentous, undifferentiated hyphae 1.8 - 6.5 μm wide, branching, densely packed, subradially arranged, sometimes with slightly thickened walls; vascular hyphae 2.2 - 17.0 μm wide, common to plentiful, branching, sometimes tightly coiling in part, best seen in scalp. **PILEUS CONTEXT:** filamentous, undifferentiated hyphae 2.8 - 14.8 μm wide, plentiful to dominant, frequently branching, loosely interwoven, only infrequently in fascicles, with walls thin or up to 0.8 μm thick, often constricted at septa, with occasional slightly inflated intercalary segments up to 15.0 μm wide; acrophysalides plentiful, elongate to narrowly clavate, up to $121 \times 34 \mu\text{m}$, with walls thin or up to 0.8 μm thick; vascular hyphae 3.5 - 15.0 μm wide, common, sinuous, occasionally branching; clamps not observed. **LAMELLA TRAMA:** bilateral, with shallow angle of divergence; $w_{\text{cs}} = (50\text{--}) 60 - 85 \mu\text{m}$ when rehydrated well; subhymenial base containing numerous intercalary thin-walled inflated cells [clavate or obclavate to ellipsoid (up to $48 \times 21 \mu\text{m}$) to fusiform or elongate or allantoid (up to $85 \times 20 \mu\text{m}$) to (rarely) globose (*e.g.*, $23 \times 22 \mu\text{m}$)]; filamentous, undifferentiated hyphae 1.5 - 11.0 μm wide, branching, with plentiful intercalary partially inflated to subfusiform to fusiform to broadly fusiform to clavate cells in central stratum (up to $52 \times 17.5 \mu\text{m}$ or larger, becoming disoriented rather easily by sectioning); divergent, terminal, inflated cells not observed; vascular hyphae 2.0 - 4.8 μm wide, sinuous, observed in only one mount (Solheim 5259)—rare. **SUBHYMENIUM:** $w_{\text{st-near}} = 40 - 75 \mu\text{m}$ when rehydrated well; $w_{\text{st-far}} = 70 - 100 \mu\text{m}$ when rehydrated well; frequently branching and rather tangled structure of short uninflated or partially inflated hyphal segments and small inflated cells, with basidia arising mostly from uninflated to partially inflated hyphal segments or from uninflated to slightly inflated branched elements, with basidia arising occasionally from small inflated cells; clamps infrequent to rare. **BASIDIA:** $36 - 83 \times 7.8 - 17.8 \mu\text{m}$, thin-walled, 4- or occasionally 2-sterigmate, with sterigmata up to $8.0 \times 5.0 \mu\text{m}$; clamps and proliferated clamps scattered (most often found near pileus margin), infrequently locally common. **UNIVERSAL VEIL:** *On pileus:* as on stipe base except exterior surface layer sometimes missing, often with much of remainder partially gelatinized; filamentous, undifferentiated hyphae in narrower fascicles than at stipe base and with diameter up to 16.2 μm , with tip cells often somewhat inflated; inflated cells up to $150 \pm \times 42 \mu\text{m}$ (almost always less than $65 \times 40 \mu\text{m}$), common to plentiful, often

badly collapsed. *At base of stipe, exterior surface:* filamentous, undifferentiated hyphae 1.8 - 8.8 μm wide, partially gelatinized to gelatinized, sometimes with walls slightly thickened, almost always in thick criss-crossing fascicles, with occasional slightly inflated terminal segment (up to 10.8 μm wide); vascular hyphae not observed. *At base of stipe, interior:* filamentous, undifferentiated hyphae 1.8 - 14.5 μm wide, frequently branching, dominating, almost always in broad fascicles, with walls up to 1.0 μm thick, with some branches out of fascicles loosely coiling, occasionally having yellowish subrefractive walls; inflated cells unevenly distributed, occasionally in loose clusters (rather commonly in Trueblood 5472), terminal, sometimes dissociated, hyaline, colorless, with walls thin or up to 1.0 μm thick, pyriform to subpyriform to broadly clavate to clavate to elongate-constricted to subfusiform to ellipsoid to ovoid to subglobose, up to $101 \times 68 \mu\text{m}$ (almost always not more than $60 \times 40 \mu\text{m}$); vascular hyphae not observed; clamps not observed. *At base of stipe, inner surface:* filamentous, undifferentiated hyphae 1.8 - 10.0 μm wide, branching, in densely packed thin layer, longitudinally oriented, partially to extensively gelatinized, fasciculate, often with thickened walls; vascular hyphae 5.0 - 8.5 μm wide, in scattered fragments, partially gelatinized. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 2.8 - 9.1 μm wide, with thin or slightly thickened walls, very frequently branching, often in rather robust fascicles, plentiful to dominant; acrophysalides plentiful, up to $264 \times 42 \mu\text{m}$, with walls thin or up to 0.5 μm thick; vascular hyphae 4.5 - 11.2 μm wide, sinuous, scattered, locally common; clamps not observed.

BASIDIOSPORES: [1140/57/22] (7.0-) 9.2 - 12.5 (-21) $\times$ (6.0-) 8.2 - 11.2 (-15.8) μm , (L = (10.0-) 10.1 - 11.8 (-12.2) μm ; L' = 10.9 μm ; W = (8.9-) 9.1 - 10.6 (-11.1) μm ; W' = 9.8 μm ; Q = (1.0-) 1.04 - 1.20 (-1.61); Q = (1.06-) 1.08 - 1.15 (-1.19); Q' = 1.11), hyaline, colorless, smooth, thin-walled, inamyloid, subglobose, occasionally globose, occasionally broadly ellipsoid, infrequently lachrimiform or langeniform, very rarely ellipsoid, often adaxially flattened, often expanded at one end; apiculus sublateral to lateral, small, truncate-conic to cylindric; contents monoguttulate; white in deposit.

Distribution and habitat: Idaho: Solitary at 1900 $\pm$ m elev. under *Populus tremuloides* Michx. with (Solheim 5259) or without (Trueblood 5472) nearby conifers. Pottawatomie Co., Kansas: August, 1990: occurring in hundreds (possibly with several mycelia each producing 25 - 150 basidiocarps) covering several acres in mowed field (within flood plain) under *P. deltoides* Marsh.; with similar large fruiting in September, 1989 (no voucher); with May, 1991 fruiting producing no more than 50 basidiocarps; with no fruiting in August, 1991. In 1992 (with plentiful rainfall and cool weather) fruitings starting in mid-May, with close to 2000 basidiocarps present simultaneously (probably from twenty or more separate mycelia) by early June; with fruiting reduced to several hundred fresh basidiocarps in third week of month; with fruiting continuing with reduction in number and size of basidiocarps until only twenty found on 27 June. [Between 1 July and 25 July 1992, area had 28.8 cm of rain.] 25 July 1992: 200 basidiocarps counted (most smaller than usual). 29 July, 1992: about 100 fresh basidiocarps in main fruiting area with scattered specimens in two other nearby sites. [Temperatures began to rise in late July, 1992 and became very hot in first week of August.] 2 August, 1992: in continuing rain,



Figs. 2-4. All anatomical drawings are scaled 570:1. Figs. 2-3. *Amanita populiphila* (holotype). 2. Elements of hymenium and subhymenial tree. 3. Elements of universal veil interior (stipe base). Fig. 4. *Amanita nivalis* (Bas 9307) elements of hymenium and subhymenial tree.

about 200 basidiocarps found in several sites. 8 August, 1992: about 150 basidiocarps (most smaller than usual) total for all sites. [During mid-August, weather remained hot and became dry.] 18 August, 1992: 12 basidiocarps in main area of occurrence, with 3 in distant site and these with darker than usual disc. 22 August, 1992: no fruiting bodies seen. [July 1992 rainfall (33.6 cm) was third highest recorded for that month for eastern Kansas region in Twentieth Century.] Michigan: Solitary to scattered on moss at edge of bog (Smith 50210). Minnesota: Subgregarious, in dark soil of old lake bottom, under *P. tremuloides*, in sparsely wooded area containing *P. tremuloides*, *Juniperus*, and plentiful young buckthorn (*Rhamnus*) scrub. New Mexico: Subgregarious to gregarious, in sod of pasture with *P. deltooides* nearby (Barrows 1090) or in dark wet loam of riparian habitat at 2410± m elev. with *P. deltooides*, *Abies*, and *Acer negundo* L. among low cover including "cow parsnips," *Rosa*, and *Spirea* (Tulloss 8-15-92-A). Wyoming: In grassy area, under *P. tremuloides*.

Collections examined: U.S.A.: IDAHO—Fremont Co. - Targhee Nat. For., 6.6 km W of Idaho/Wyoming state line, 2.viii.1957 W. G. Solheim 5259 (MICH). Owyhee Co. - Vulcan Crk., 7.vii.1973 Ellen & Ted Trueblood 5472 (MICH). KANSAS—Pottawatomie Co. - N of Manhattan, Tuttle Creek St. Pk., River Pond Area, 11-13.viii.1990 W. R. & E. Moses *s.n.* [Tulloss 8-11/13-90-EM1], 25.viii.1990 W. R. & E. Moses *s.n.* [Tulloss 8-25-90-EM1], 25.v.1991 W. R. & E. Moses *s.n.* [Tulloss 5-25-91-EM1], 15.v.1992 W. R. & E. Moses *s.n.* [Tulloss 5-15-92-EM1] (holotype, NY; isotype, RET), 22.v.1992 W. R. & E. Moses *s.n.* [Tulloss 5-22-92-EM1], 25.v.1992 W. R. & E. Moses *s.n.* [Tulloss 5-25-92-EM1] (L; RET), 30.v.1992 W. R. & E. Moses *s.n.* [Tulloss 5-30-92-EM1], 5.vi.1992 W. R. & E. Moses 1 (NY), 2, 3, & 4. Rooks Co. - Stockton, 1.ix.1908 Elam Bartholomew *s.n.* (FH as "*A. nivalis*"). Co. unknown - locality unknown, 18.vi.1967 Harbaugh 67-6-18-1 (MICH). MICHIGAN—Luce Co. - Tahquamenon St. Pk., 22.viii.1965 Alexander H. Smith 50210 (MICH). Oakland Co. - Highland Recreation Area, 22.vii.1973 A. H. Smith 84263 (MICH). MINNESOTA—Washington Co. - Afton, 11.vii.1993 Anna Gerenday 9307. MONTANA—Gallatin Co. - Bozeman, divide btwn. Bridger & Kelly Cyn., 2.vii.1957 F. B. Cotner 570039 (MICH). NEW MEXICO—Colfax Co. - Colin Nesblett Wildlife Area, Tolby Creek, 15.viii.1992 NAMA '92 foray participant *s.n.* [Tulloss 8-15-92-A]. Rio Arriba Co. - El Rito, viii.1959 Charles Barrows 1090 (MICH). WYOMING—Teton Co. - Grand Teton Nat. Pk., Reid Mtn., 26.viii.1983 Kent H. McKnight & Meinhard Moser [McKnight 83082610] (BPI as "*A. alba*").

DISCUSSION

In 1990, Moses and her husband cooked up a batch of *A. populiphila*, ate it entirely, and noticed no ill effects whatever. They enjoyed the mushroom again in May, 1992 and note that it ranks as a "good" edible and that the stipe is "pleasantly crispy." Particularly since the species is white or pallid, persons collecting it for the table must be very careful not to confuse it with one of the poisonous white species of *Amanita* section *Phalloideae* (Fr.) Quél.

To justify the novelty of *A. populiphila* it is necessary to compare it to taxa with

similar spores and somewhat weakly structured universal veil (but neither friable, nor with a strong tendency to turn gray at maturity)—*A. arctica* Bas *et al.* in Knudsen & Borgen (1987); *A. lividopallescens* (Secr. *ex* Gillet) Seyot (1930); and *A. nivalis* Grev. (1822).

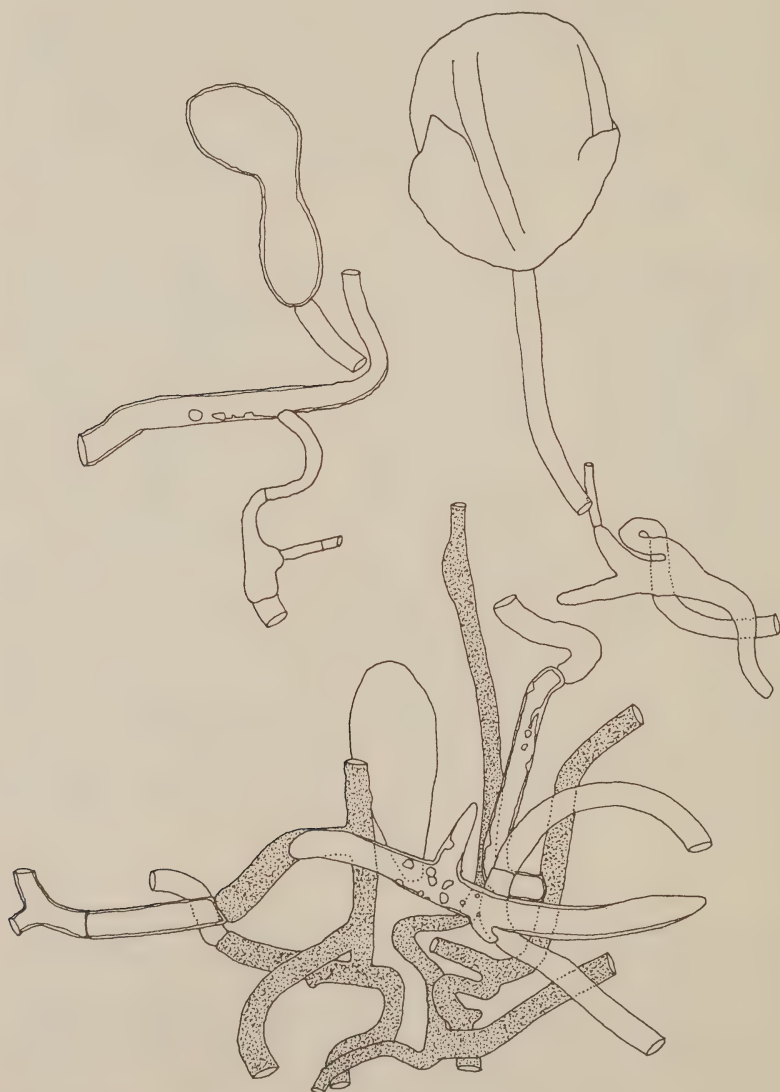


Fig. 5. *Amanita nivalis* (Bas 9307) elements of universal veil interior (stipe base).

Amanita arctica was described from Greenland where it is found associated with *Betula* and *Salix*. According to Tulloss (1994), *A. arctica* has a cellular (pseudoparenchymatous) subhymenium, an universal veil more membranous than in *A. populiphila* (when some is left on the pileus, it is in the form of a single patch), and larger spores ($L = 11.0 - 11.9 \mu m$; $W = 9.9 - 10.8 \mu m$).

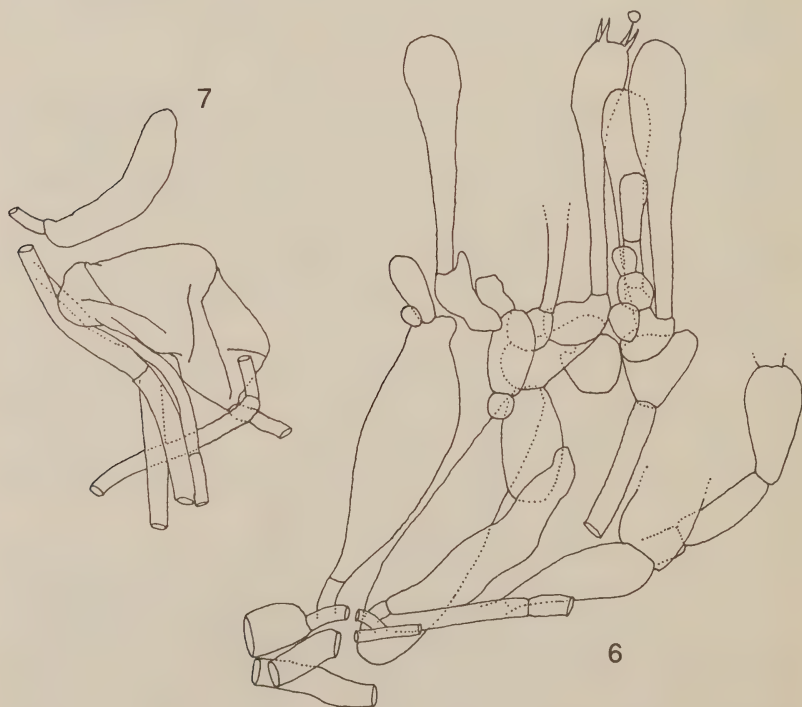
Amanita lividopallescens of Europe is a species often producing very large basidiocarps, the pilei of which are grayish ochraceous at first and become more pallid with age. While its universal veil is somewhat weak, it is often illustrated with a complete, copious, saccate volva. Boudier (1907), whose color plate is considered by many to be the definitive illustration of this species, depicts a large, saccate volva with tears in it. Fraiture (1993) gives the volva of *A. lividopallescens* as the example of his category Ib of volval forms ("voile fragile, très peu membraneux, abandonnant ordinairement des lambeaux sur le chapeau, formant au bas du pied une volve généralement morcelée"). Boudier (1907) described the stipe of *A. lividopallescens* as being up to 250 mm long and its spores as $12 - 16 \mu m$ in diameter. Romagnesi (1982) reported a collection of what he determined to be this species having spores $10 - 13.5 \mu m$ in diameter. Hence, *A. lividopallescens* differs from *A. populiphila* at least in having a somewhat more coherent universal veil, larger spores, a pileus that is not white at first, and (often) a larger habit.

Amanita nivalis, described from Scotland, is a rather small species that (contrary to some interpretations) is infrequently white at maturity (Watling, 1985; 1987). It is associated with dwarf *Salix* in arctic-alpine environments. Tulloss has examined the neotype (E) and additional material from Norway, Sweden, and Switzerland (BERN, L, and RET) including Bas 9307 (L; RET). In the subhymenial base of *A. nivalis* (Fig. 4) there are fewer inflated cells than in the same structure of *A. populiphila*, except in the portion of a lamella rather close to the pileus context. The pileipellis of *A. nivalis* is only about half as thick as that of *A. populiphila* and the filamentous, undifferentiated hyphae at the surface of the pileipellis in the European species are criss-crossed rather than subradially oriented. Vascular hyphae are lacking in the pileus context of *A. nivalis* except in the region near the stipe apex, and acrophysalides dominate in the stipe context of *A. nivalis*. In the interior of the universal veil of *A. nivalis* (Fig. 5), the filamentous, undifferentiated hyphae are not so commonly fasciculate as in *A. populiphila*; and any fascicles are loosely constructed. Moreover, these hyphae include intercalary segments swollen up to $30 \mu m$ wide; and there are common, branching and knotted vascular hyphae throughout the tissue.

Amanita populiphila has been mistaken for *A. vaginata* var. *alba*. According to Dr. C. Bas (pers. comm.), *A. vaginata* var. *alba* is probably not interpreted in the same way by all European mycologists. Heinemann's key (1964) says *A. vaginata* var. *alba* is usually entirely white, but with the cap sometimes slightly ochraceous in the disc and that the universal veil remains entire at the base of the stipe. Fraiture (1993) describes the universal veil as membranous—belonging in his volval form category III. Merlo & Traverso (1983) depict *A. vaginata* var. *alba* as a mushroom with a membranous universal veil of proportions like those seen in *A. fulva* (Schaeff.) Fr. and a pileus that is entirely white with rather long marginal striation (nearly 0.5R). Gilbert (1940-41) describes *A. vaginata* var. *alba* similarly and adds that the

spores are $11.5 - 13.5 \mu\text{m}$ in diameter. Therefore, based on recent literature, *A. populiphila* differs from apparently commonly held European concepts of *A. vaginata* var. *alba* by having a less membranous universal veil, shorter marginal striation on the pileus, and smaller spores. Also, *A. vaginata* (Bull.:Fr.) Vitt. has a stipe base that is intergrown with the universal veil so that the latter does not separate from the stipe as in *A. populiphila* [e.g., see illustration of Bon (1987: 295)].

Amanita vaginata var. *alba* is described as "a tall, elegant fungus and much the same in stature as *A. fulva*" by Watling (1987) whose concept is based on collections from upland *Betula* woods in northern Scotland. Tulloss examined a specimen from Perthshire [6.ix.1984 R. Watling 17518 (E)]. Spore measurement data from this specimen is as follows: $[40/1/1] (9.8-) 11.0 - 13.0 (-13.8) \times (9.0-) 10.0 - 12.2 (-13.2) \mu\text{m}$, ($L = 11.9 \mu\text{m}$; $W = 11.0 \mu\text{m}$; $Q = (1.02-) 1.03 - 1.13 (-1.28)$; $Q = 1.08$). The subhymenial base in this specimen (Fig. 6) is composed of long, narrow, often curving cells and is thus well-differentiated from a relatively narrow subhymenium ($10 - 35 \mu\text{m}$ from edge adjacent to subhymenial base to nearest base of



Figs. 6-7. *Amanita vaginata* var. *alba* sensu Watling (Watling 17518). 6. Elements of hymenium and subhymenial tree. 7. Elements of universal veil interior (stipe base).

basidium; 35 - 60 μm from edge adjacent to subhymenial base to most distant base of basidium) composed of uninflated or partially inflated hyphal segments and small, irregular, inflated cells (up to $18.0 \times 18.0 \mu\text{m}$, but usually considerably smaller in at least one dimension) in a branching structure. The central stratum is 40 - 60 μm wide. Parameters of the subhymenial tree (very good rehydration) are $w_{\text{st-near}} = 60$ - 85 (-125) μm ; $w_{\text{st-far}} = 95$ - 110 (-145) μm . Clamps were not observed in any tissue. Moreover, in the Scottish collection, inflated cells and hyphae of the universal veil interior were thin-walled (Fig. 7). Hence, *A. vaginata* var. *alba* sensu Watling is easily distinguished from *A. populiphila*.

According to an unpublished manuscript (MICH), A. H. Smith recognized this taxon as a new species assigning it at least one manuscript name. Notes filed in MICH for Trueblood 5472 indicate that E. Trueblood was not successful in an attempt to start a culture from that material.

In the past we have referred to *A. populiphila* as "species KS1" in checklists and correspondence.

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We sincerely thank the following persons: Dr. C. Bas, L, for enlightening discussions and correspondence and for his reviewing this paper; Dr. Richard Beeman, Manhattan, Kansas, for providing Moses with macrochemical test reagents; Drs. Jean Boise Cargill and Donald H. Pfister and Mr. Gennaro Cacavio, FH, for their support during visits to their institution; Ms. Lori Fansler, St. George, Kansas, for photographs of Moses' collections of *A. populiphila*; Dr. W. R. Moses for companionship in the field and out and for supportive spade work; Dr. Amy Y. Rossman and Ms. Loretta Alessandrini, BPI, for loan of material and their kindnesses during Tulloss' visit to their institution; Dr. Beatrice Senn-Irlet, BERN, for loan of Swiss collections of *A. nivalis*; Dr. Robert L. Shaffer and Ms. Pat Rogers, MICH, for loans of material and for hosting Tulloss during his visit to their institution; Mr. David C. Tulloss, Berkeley, California, for preparing the habit illustration of *A. populiphila*; Ms. Mary Tulloss, Roosevelt, New Jersey, for her assistance in preparing the paper for publication; and Dr. Roy Watling, E, for loan of material. Tulloss is grateful for support from the Alexander H. and Helen V. Smith Fund (Mycological Society of America) that enabled him to spend fruitful days in MICH.

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NEW COMBINATIONS IN MELASTIZA AND SCUTELLINIA (PEZIZALES)

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ABSTRACT

Two new combinations, *Melastiza contorta* and *Scutellinia citrina*, for names both cited under *Ciliaria* in British literature, are proposed after examination of type material. Full descriptions are given of these two species, with a revision of the type of the former. Several synonyms of these two species are considered.

Key words: taxonomy, new combination, *Lachnea contorta*, *Sphaerospora citrina*.

Lachnea contorta Massee & Crossl. and *Sphaerospora citrina* Massee & Crossl. were described early this century (Massee and Crossland, 1901; Anon., 1904). The former was combined in *Ciliaria* by Boudier (1907b) and was considered by Schumacher (1988) to be an immature species of *Melastiza*. *Sphaerospora citrina* seems to have been ignored by international researchers, although it was combined in *Ciliaria* by Boudier (in Ramsbottom, 1914) and is still recognized in the Checklist of British Ascomycotina (Cannon, *et al.*, 1985). During the work undertaken for the 'Ascomycetes of Great Britain and Ireland' project, the authors investigated names listed by Cannon, *et al.* (1985) under *Ciliaria* Quéél. ex Boud. Examination of type material of these names shows that *C. contorta*

(Massee & Crossl.) Boud., with spore ornamentation composed of large, irregular warts, is indeed a member of the genus *Melastiza*, and that *C. citrina* (Massee & Crossl.) Boud., with ornamented globose ascospores, belongs to *Scutellinia*. As a result, the two new combinations are proposed in the present paper. Because the original description of *L. contorta* is inadequate and does not well represent the type, a revised description of the type is provided here. A full description of *S. citrina* is also given based on examination of the type material. Several later synonyms are considered and a subspecific taxon, *Scutellinia paludicola* (Boud.) Le Gal spp. *megalosphaera* (Dissing) T. Schumach., is also discussed.

MATERIAL AND METHODS

Light microscopy

Herbarium specimens were examined under the dissecting microscope. Apothecia were rehydrated in either 10% ammonia solution or distilled water, and a small piece from the margin and/or disc was dissected using a scalpel. The sample from the apothecium was mounted in distilled water and examined under the compound light microscope for colour, then stained with Melzer's Reagent, by flooding under the coverslip, to determine appropriate staining reactions. After the examination, lactophenol cotton blue was introduced to replace the mountant and the preparation sealed by ringing the coverslip with Glyceel so as to prepare a semi-permanent mount. Where possible, measurements of hairs, asci, ascospores and paraphyses were made from material mounted in water. However, measurement of some characters, especially the spore ornamentation, is facilitated by observation in lactophenol cotton blue and was, therefore, made in this medium. For observation and measurement of spore ornamentation an oil-immersion lens (x 100) was employed. The line drawings were made by using a drawing-tube attachment.

Scanning electron microscopy (SEM)

A small piece of the apothecium was taken from the herbarium specimen under the dissecting microscope and placed in a drop of distilled water on a portion of glass coverslip which had been cut into 5.0 - 8.0 mm squares. The sample was manipulated with needles or scalpel under the dissecting microscope to release ascospores from the asci. The debris of the apothecium was, if required, transferred to another coverslip to make further

preparations. Where shot ascospores were available, a small quantity of the ascospores was picked up using a needle and suspended in a drop of distilled water on a portion of glass coverslip. After air drying, the coverslip with ascospore preparation was mounted on a 1.0 - 1.2 mm diam. aluminium stub using double-sided 'sellotape' and painted with Evo-Stik Wood Adhesive (Evo-de Ltd.) along the edges. The preparation was coated with platinum in a Balzers SCD 030 sputter coater for 3 minutes and then examined in a HITACHI SC scanning electron microscope at 18 Kv of electron beam. The photographs were taken on Polaroid films.

REVISION, DESCRIPTIONS AND TAXONOMIC ASPECTS

Melastiza contorta (Massee & Crossl.) Spooner & Y. J. Yao, *comb. nov.* Figs 1, 2, 3A & B

≡ *Lachnea contorta* Massee & Crossl. in *Naturalist, Hull* **1901**: 182. 1901.

≡ *Ciliaria contorta* (Massee & Crossl.) Boud., *Hist. Classific. Discomyc. Europe* p. 61. 1907.

= *Melastiza scotica* Graddon in *Trans. Br. Mycol. Soc.* **44**: 609. 1961.

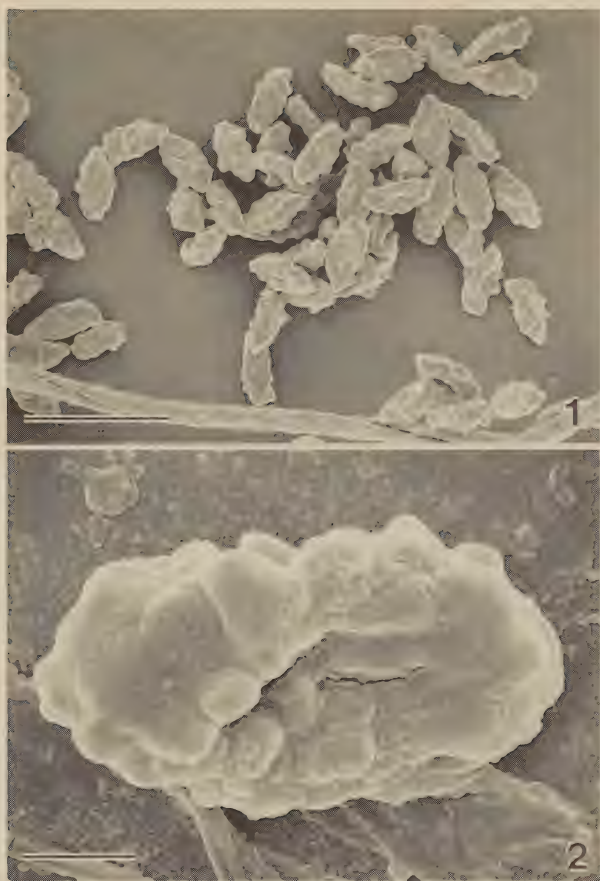
Apothecia gregarious, 3.0 - 5.0 mm diam., sub-sessile, shallow cupulate. **Disc** concave, brownish grey to brown when dried, marginate. **Marginal and receptacular hairs** similar, yellow brown or pale yellow brown, often paler above, multi-septate, straight or curved, somewhat flexuous, almost cylindric, slightly tapered, obtuse at the apex, base simple, superficial, 150 - 350 x 17.0 - 25.0 μm , wall thin, 0.5 - 1.0 μm . **Asci** I-, cylindric, stipitate, 380 - 400 x ca 20 μm , 8-spored. **Ascospores** colourless, ellipsoid, 24.0 - 28.0 x 13.0 - 15.0 μm excluding ornamentation, 2-guttulate or guttulation indistinct. **Spore ornamentation** of large, irregular warts, (1.2 -) 3.0 - 5.0 μm across, up to 14.0 μm across covering the poles, 3.0 - 5.0 μm high at poles and 1.0 - 2.0 μm high elsewhere, sometimes with narrow connecting bands. **Paraphyses** filiform, septate, slightly enlarged at the apex, to 3.0 - 5.0 μm diam.

Specimens examined: England, Yorkshire, Selby, on ground, October 1896, *sine leg.* (K, type, cited as 'on naked ground, Selby, Mid West Yorkshire (G. Massee)' by Massee and Crossland (1901)); Somerset, Porlock, in conifer plantation (mostly *Larix*) at the top of the Toll Road, 29 Aug. 1954, D. A. and P. M. Reid (K, paratype of *M. scotica*). Scotland,

North Scotland, moss/pines, Aug. 1957, R. Watling (K, ex Herb. Graddon 1227, type of *Melastiza scotica*, cited as 'Inter sphagna in pinetis, Cannich, Inverness, Sept. 1957, leg. R. Watling' by Graddon (1961)); Inverness, Rothiemurchus, Glen Einich, in wood amongst pine debris, 14 Sept. 1957, D. A. Reid (K, paratype of *M. scotica*); Rothiemurchus, moss/pines, Aug. 1960, P. D. Orton (K, ex Herb. Graddon 1451, paratype of *M. scotica*); Perthshire, Rannoch, peaty soil, Oct. 1960, P. D. Orton (K, ex Herb. Graddon 1467, paratype of *M. scotica*, cited as 'amongst moss in pine wood' by Graddon (1961)).

Lachnea contorta was erroneously described as having smooth and eguttulate ascospores. The above description is therefore provided, based on revision of the type material. Examination of this material, which comprises two apothecia, shows distinct ornamentation on fully developed ascospores, although there are young ascospores which appear smooth. The guttulae in the ascospores are not always very distinct, but are clearly visible in some. The essential characters of *L. contorta* are also shared by *Melastiza scotica* Graddon, the type of which comprises gregarious apothecia, 2.0 - 9.0 mm diam. when dried; hairs 120 - 560 x 11.0 - 20.0 μm with walls 0.5 - 1.5 μm thick; ascospores 22.0 - 25.5 x 12.0 - 13.5 μm , spore ornamentation up to 6.5 μm high at poles. We consider that the types of *M. scotica* and *L. contorta* are conspecific, and the combination of *L. contorta* in *Melastiza* is therefore proposed, with *M. scotica* reduced to synonymy.

Schumacher (1988) designated a specimen in K (England, Selby, Mid West Yorkshire, leg. Masee, *sine dat.*) as lectotype of *L. contorta*. He stated the material to be immature and referred it to *Melastiza* as 'probably *M. chateri* (W. G. Sm.) Boud.' In fact, the designation of lectotype for *L. contorta* is unnecessary because Masee and Crossland (1901) cited in the protologue only one specimen, which must be regarded as the holotype of this species, although the date of that collection was not given. The specimen cited for the present description is the only specimen labelled *Lachnea contorta* in K; it clearly bears the date on the label, but lacks the collector's name. However, there can be little doubt that it is the specimen on which Masee and Crossland (1901) based their new species. The locality and the collection date, which is earlier than that of the publication, are appropriate, and the label, '*Lachnea contorta* Mass (pro tem), on ground, Selby, X/96', suggests that it is at least part of the original collection. It should, therefore, be regarded as the holotype (or isotype: further material may be



Figs 1 and 2. Scanning electron microscopy of ascospores of *Melastiza contorta*. 1. Paratype of *M. scotica* from Porlock. Bar= 50 μ m. 2. Type of *M. scotica*. Bar= 5 μ m.

available in NY). No specimen labelled as cited for the lectotype by Schumacher (1988) can be located in K.

The five paratype collections of *M. scotica* cited by Graddon (1961) have been examined by the authors. These agree well with the above description, except that from Ireland (Co. Dublin, Killakee Mt., on burnt peaty soil, 26 Nov. 1955, F. C. Hassall, at K). This specimen appears to be a younger collection, having similar hair characters but without ornamented ascospores. The type and two of

the paratypes (Graddon 1451 and 1467) comprise gregarious apothecia. Some thicker-walled hairs (walls 2.0 - 2.5 μm thick) occur in Graddon 1467 and in the collection from Ireland, while most hairs in these collections are thin-walled (walls 0.5 - 1.0 μm thick). The largest apothecium, found in the collection from Somerset, measures 16 mm diam. in the dry state. This specimen is accompanied by a small package of shot ascospores. The dust of the ascospores is yellowish-white in colour and the SEM photograph from these spores is presented here (Fig. 1).

The citation of the specimens by Graddon (1961) is not exactly as on the labels, possibly due to errors in transcription when relabelling the specimen. However, the specimen numbers, and the appropriate localities and collectors confirm the identity and status of the collections.

SEM photographs of ascospores (Figs 1, 2) do not clearly show the ornamentation as observed under the light microscope. This is probably due to the presence of mucilaginous material which partially obscures the warts when coated for SEM study.

Scutellinia citrina (Masse & Crossl.) Y. J. Yao & Spooner, comb. nov. Figs 3C - E

≡ *Sphaerospora citrina* Masse & Crossl. in *Naturalist, Hull* **1904**: 4, 1904.

≡ *Ciliaria citrina* (Masse & Crossl.) Boud. in Ramsbottom in *Trans. Br. Mycol. Soc.* **4**: 367. 1914.

= *Ciliaria trechispora* (Berk. & Broome) Boud. var. *paludicola* Boud., *Icon. Mycol. Sér. 3, Livr. 12.* p. 10 (Tom. 2, Pl. 376). 1907.

≡ *Sphaerospora trechispora* (Berk. & Broome) Sacc. f. *paludicola* (Boud.) Svrcek in *Sborn. Nár. Mus. Praze* **4B**(6): 67. 1949 [as 1948].

≡ *Scutellinia paludicola* (Boud.) Le Gal in *Bull. Soc. Mycol. France* **82**: 307. 1966.

≡ *Scutellinia trechispora* (Berk. & Broome) Lambotte var. *paludicola* (Boud.) J. Moravec in *Ceská Mykol.* **23**: 29. 1969.

≡ *Scutellinia barlae* (Boud.) Maire f. *paludicola* (Boud.) Donadini in *Docum. Mycol.* **13**(49): 29 (1983).

Apothecium approximately 4.0 mm diam., sessile, shallow cupulate. **Disc** concave, light yellow when dried, with indistinct margin. **Marginal and receptacular hairs** similar, those at the margin slightly stiffer, longer and broader, brownish orange to



Fig. 3. Camera lucida drawings of *Melastiza contorta* and *Scutellinia citrina*. A - B. Ascospores of *Melastiza contorta*. A. Type. B. Type of *M. scotica*. C - E. *Scutellinia citrina*. C. Ascospores from Watling 5294. D. Hairs from type. E. Ascospores from type. Bar = 20 μm for A - C and E, 40 μm for D.

brown, paler towards the apex, curved, flexuous or straight, broadest at mid-length, tapering to both ends, mostly pointed at the apex, base simple, rooting, 120 - 340 x 10.0 - 20.0 μm , wall 3.0 - 5.0 μm thick, 0 - 3-septate, interspersed with short, clavate, obtuse, dull yellow to brownish orange, aseptate hairs, 30.0 - 110 x 8.0 - 20.0 (- 26.0) μm , wall thin, to 2.0 μm thick. **Asci** I-, cylindric, stipitate, 260 - 340 x 30.0 - 36.0 μm , 8-spored. **Ascospores** colourless, globose, sometimes slightly subglobose, 24.5 - 30.5 (- 33.0) x 24.0 - 30.5 (- 32.0) μm excluding ornamentation, multi-guttulate. **Spore ornamentation** of large, prominent warts, (1.0 -) 2.0 - 3.0 (- 4.0) μm across, (1.5 -) 2.0 - 2.5 μm high, interspersed with smaller warts, (0.3 -) 0.5 - 1.0 μm across, rarely a few becoming confluent. **Paraphyses** 4.0 - 6.0 μm broad, filiform, septate, apically clavate, enlarged to 10.0 - 15.0 μm broad at the

Specimens examined: **England**, Yorkshire, Redcar, on turfy ground, Sept. 1901, E. M. Holmes (NY, holotype of *Sphaerospora citrina*, labelled as *Lachnea citrina*); Lancashire, South Lancashire, sand hills, June 1920, W. G. Travis (K, labelled as *Sphaerospora asperior* Sacc.). **Scotland**, East Lothian, Aberlady, on soily part of depression but very wet, 28 Aug. 1967, Roy Watling, No. 5294 (E); Dundee, Herb. Buckley, 12 July 1930, *sine leg.* (K, labelled as *Ciliaria asperior* Sacc. [sic]).

Sphaerospora citrina has been virtually ignored since it was published although it has been mentioned several times in the British literature (e.g. Smith, 1904; Massee and Crossland, 1905). It was combined in *Ciliaria* (Ramsbottom, 1914) and listed as *Ciliaria citrina* (Massee & Crossl.) Boud. ex Ramsb. in Ramsbottom and Balfour-Browne (1951) and Cannon, *et al.* (1985). Examination of the type material shows it to exhibit the same microcharacters as *Scutellinia paludicola* (Boud.) Le Gal, recognised by Le Gal (1966) and Schumacher (1990). *Sphaerospora citrina* provides an earlier name for this taxon. The appropriate combination in *Scutellinia* is, therefore, proposed, and *Ciliaria trechispora* (Berk. & Broome) Boud. var. *paludicola* Boud. is reduced to synonymy.

The existing type material of *Sphaerospora citrina* comprises a single incomplete apothecium. The above description is based on the examination of this material. The short, clavate hairs, which were illustrated by Boudier (1907a) for *C. trechispora* var. *paludicola*, but not mentioned in the description provided by Schumacher (1990) for *Scutellinia paludicola*, are present among the longer, acuminate hairs on the apothecium. The label on the type indicates the habitat as turfy ground which was altered in the protologue to 'peaty ground'. The collection made by R. Watling from Scotland was examined by Schumacher (1990) who wrongly cited the collection date (28 Aug. 1967) as 25 Oct. 1967. This material is very scanty, comprising a small fragment of a single apothecium. The smallest ascospore measurement made from this collection is $23.0 \times 22.0 \mu\text{m}$ but the ascospore size range ($(23.0 -) 24.0 - 28.5 (- 33.0) \times (22.0 -) 23.5 - 28.5 (- 33.0) \mu\text{m}$) is similar to that of the type of *Sphaerospora citrina*. The warts on the spores tend to be slightly larger than those of the type, measuring from $2.0 - 4.0 \mu\text{m}$ across, $(1.5 -) 2.0 - 4.0$ high, but this minute difference cannot be considered as specifically significant.

Two further British specimens, previously referred to

Sphaerospora asperior (Nyl.) Sacc. or *Ciliaria asperior* (Nyl.) Boud., have been redetermined as *Scutellinia citrina*. One of these, from Lancashire, consists of a single apothecium, approximately 3.0 mm diam. and dull brownish-orange when dried. The other, from Dundee, contains about 20 apothecia, measuring 1.5 - 3.0 mm diam., with hymenium from yellow to dark brown when dried. The size of ascospores and of spore ornaments in these two collections are within the same range as those of the type.

It is interesting to note that there was another collection from Yorkshire made by Crossland from Halifax. This was sent to Boudier who identified it as *Ciliaria trechispora* var. *paludicola* (Le Gal, 1966). A colour painting, accompanied by a description of a collection from Lancashire (North of Southport, seashore, 29 Aug. 1909, J. A. Wheldon) is preserved in K. This matches the above description well, and was, again, named as *Ciliaria trechispora* var. *paludicola*. The only difference between the original published descriptions of *Sphaerospora citrina* and *Ciliaria trechispora* var. *paludicola* concerns the disc colour. *Sphaerospora citrina* was described as having disc '*amoene lutea*', as is also figured in the original painting by Massee in K. The illustration of *Ciliaria trechispora* var. *paludicola* by Boudier (1907a) shows red discs. Judging from the similarity in other characters we consider that the difference of colouration in the original description represents variation of the species, but this requires confirmation from further fresh collections.

Le Gal (1966) compared several specimens with the original illustration by Boudier (1907a) and incorrectly considered the collection from Halifax by Crossland as the holotype. Schumacher (1990) rejected Le Gal's assumption and selected the specimen from 'les marais d'Arronville, 30 May 1899' as lectotype, on the basis that it was cited by Boudier (1910) as syntype. However, the protologue was, in fact, published by Boudier (1907a) with only one cited specimen, from Montmorency. It is obvious that the collection from Halifax cannot be regarded as holotype, and that the specimen selected by Schumacher (1990) cannot serve as lectotype simply because the specimen from Arronville is not a syntype, although it was mentioned in the later compilation of *Icones Mycologicae* (Boudier, 1910). If the original specimen cannot be positively identified, then the original illustration by Boudier will be sufficient to represent the species (in accordance with Article 9.3 of the ICBN, Greuter *et al.*, 1988).

When this species was reported from Britain by Schumacher

(1990, as *S. paludicola*), it was known from a single, fragmentary collection. However, as noted above, earlier British collections have been made, misdetermined as *Sphaerospora asperior* (Nyl.) Sacc. or *Ciliaria asperior* (Nyl.) Boud., and the species is now known to have been previously described by Masee and Crossland. The true distribution of this species in Britain may, therefore, be much wider than expected.

Schumacher (1990) considered *Scutellinia megalosphaera* Dissing as merely a geographical race of *Scutellinia paludicola*. We have not examined the type material, although the SEM photograph of the species provided by Dissing (1981) shows rather smaller and more densely distributed warts on the ascospore. Furthermore, the warts on the spores were described as 1.0 μm high and as sometimes interconnected, which is considerably different from the pattern seen in the type of *S. citrina*. Whether it should be treated as a geographical race of that species or as specifically distinct is better left to be decided after examination of the type and further collections from Greenland.

ACKNOWLEDGEMENTS

We wish to thank Dr R. W. G. Dennis for valuable discussion and helpful advice, and for reading the manuscript. Thanks are also due to Professor R. P. Korf for helpful comments on the manuscript and presubmission review. This work has been carried out as part of the project 'The Ascomycetes of Great Britain and Ireland'. This project is funded by a grant (GR3/8284) from the Natural Environmental Research Council.

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**LECANORA SECT. PETRASTERION
(LICHENIZED ASCOMYCOTINA) IN NORTH
AMERICA: *LECANORA PUEBLAE* SP. NOV., FROM MEXICO
AND *LECANORA KOFÆ* SP. NOV., FROM ARIZONA**

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ABSTRACT: Two new species of *Lecanora* subg. *Placodium* sect. *Petrasterion* are described from North America. *Lecanora pueblae* Ryan & Nash, sp. nov., from Puebla, Mexico, on limestone, is rather similar to *L. sonorae* Ryan & Nash in general appearance and also contains usnic and psoromic acids as the only lichen substances, but differs especially as follows: 1) thallus thinner, more appressed; 2) lobes narrower, more elongate, contiguous, somewhat convex; 3) surface smooth, continuous, and somewhat glossy, with concolorous edges; 4) apothecial discs glossier, often reddish brown; 5) occurrence on limestone rather than siliceous rock.

Lecanora kofæ Ryan & Nash, sp. nov., from Arizona, is superficially somewhat similar to *Squamarina (Petroplaca) degelii* Poelt and like that species contains usnic and roccellic acids, but *L. kofæ* has a more flattened and distinctly rosulate thallus with somewhat elongated marginal lobes, and has cortical hyphal bundles dividing the algal layer. *Lecanora kofæ* also shows considerable similarities, in external appearance and in cortical structure, to forms of *L. bipruinosa* Fink, but (as in *L. pueblae*) has epruinose apothecial discs and differs in medullary chemistry. The two new species are of uncertain affinities within *Petrasterion*, but they (and *L. sonorae*) may be closer to *L. bipruinosa* than to other members of the section.

This article is one of a series in which we deal with *Lecanora* subg. *Placodium* sect. *Petrasterion* Poelt in North America. Its purpose is to describe two new species which we feel are distinctive enough to warrant recognition, even though they are presently known only from single or few collections. The two species are rather different from each other, and both are of uncertain affinities within the section, but show at least some superficial similarities to *Lecanora bipruinosa* Fink.

METHODS

Unless noted otherwise, the methods and terminology used in this article follow those described by Ryan (1989a, 1989b).

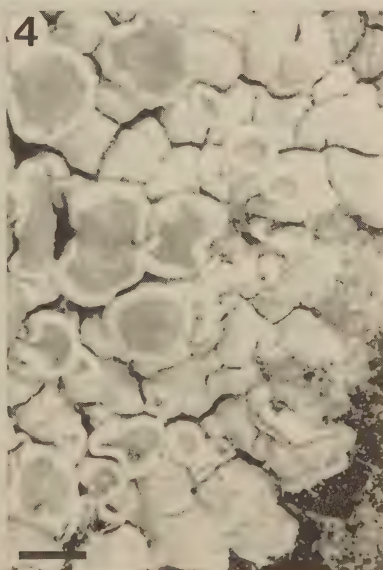
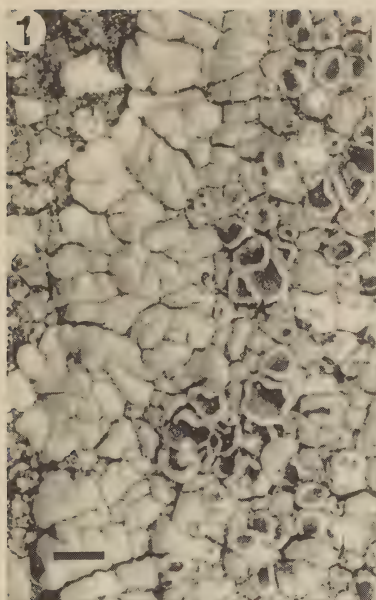
RESULTS AND DISCUSSION

Lecanora pueblae Ryan & Nash, sp. nov. (Figures 1-2)

Type: MEXICO. PUEBLA. Atlixco, hill along the road just NE of the town, near the village Santa Ana, 18°56'N, 98°25'W, 2000 m, on limestone, 24 January 1991, Timdal 7453, **holotype** (O), **isotype** (ASU!).

In rupibus calcareis crescens, Mexico. Subsimilis *Lecanora sonorae* sed thallus tenuior et appressis, lobi comparate angustis et elongatis, contiguus, convexus, superficies laevis, continuus, comparate nitidus, ad margines concoloris, et disci apotheciorum aliquantum nitidis, saepe demum castaneis. Cortex continent acidum usnicum, medulla continet acidum psoromicum.

Figures 1-2. *Lecanora pueblae* Ryan & Nash, isotype (Timdal 7543, ASU). Figures 3-4. *Lecanora kofae* Ryan & Nash, 3. Holotype (Ryan 30873, ASU). Another representative specimen (Ryan 16070, GZU). Scale (Figs. 1-4) = 1 mm.



THALLUS at first consisting of irregularly shaped crenate to weakly incised areoles, which develop into distinct flattened rosettes to ca. 2.5 cm across, to 0.5 mm thick in the center, tightly adnate throughout, distinctly radiately lobed at the periphery, with a somewhat irregular outline; **thallus center** areolate; areoles contiguous, irregularly roundish to subangular, ca. 0.5-1 mm across, planar to slightly convex; **lobes** discrete to contiguous but separated by cracks, often transversely cracked towards the thallus center, planar to moderately convex, ca. 1.5-3 mm long, 1-1.5(-2) mm wide, ca. 200 μ m thick, coarsely but strongly crenate to incised, the ultimate segments ca. 0.5-1 mm wide; **upper surface** epruinose, somewhat glossy, pale yellowish green (121) to grayish greenish yellow (105); **upper cortex** ca. 50 μ m thick, conglutinate, apparently true (without dead algal cells) and appearing almost paraplectenchymatous, the hyphae somewhat anticlinally oriented and slightly elongated in that direction, ca. 3 μ m wide, with 1 mm wide lumina; lower part hyaline; upper 15-20 μ m interspersed with yellowish brown granules (soluble in K), without dead algal cells but with the hyphae strongly gelatinized and indistinct, grading into a thin non-interspersed epinecral layer; **algal layer** ca. 50-75 μ m thick, interrupted here and there by narrow hyphal bundles; algae trebouxoid, ca. 8-10 μ m diam.; **medulla** rather dense, filled with grayish granules (insoluble in K); hyphae variously oriented, ca. 5 μ m diameter, with narrow, elongated lumina; **lower cortex** not developed except near tips or edges.

APOTHECIA common, becoming crowded, borne submarginally 1(-3) per areole, soon sessile, becoming constricted at the base, to 1 mm diameter; **discs** plane, epruinose, rather glossy (especially when young), mostly brownish orange (54) to strong brown (55), to strong yellowish brown (74) or strong to deep reddish brown (40-41), or (on other thalli, probably from a more shaded area) pale yellow (89) to light yellowish brown (76) or moderate orange-yellow (71); **thalline margins** ca. 0.2 mm wide, becoming flexuous and somewhat unevenly broadened, somewhat raised, persistent, concolorous with

the thallus; **cortex** false (with numerous dead algal cells), ca. 25 μm thick; outer 15 μm inspersed; hyphae somewhat anticlinally oriented and elongated, ca. 2 μm diameter with 0.5-1 mm wide lumina); **algal layer** filling most of the upper part of the margin, absent in the lower part, well developed below the hypothecium, ca. 60 μm thick, interrupted here and there; **medulla** similar to that of thallus; **excipulum** hyaline, conglutinate; hyphae mostly periclinal to the surface of the disc (curving upwards towards the margin), ca. 1.5-2 μm thick, with narrow, elongated lumina; **hypothecium** ca. 50 μm thick, with a few narrow bundles of anticlinal hyphae penetrating the algal layer; **subhymenium** ca. 50 μm thick; **hymenium** ca. 60 μm high, hyaline; **epihymenium** ca. 15 μm thick, yellowish to reddish brown, inspersed with fine granules (soluble in K), covered by a distinct hyaline, non-inspersed. layer 5-10 μm thick; **paraphyses** coherent, mostly simple, ca. 1.5-2 μm wide; cells ca. 3 μm long; lumina ca. 1 μm wide; tips clavate, to 3-4 μm thick, hyaline; **asci** clavate; **spores** simple, hyaline, 8 per ascus, rather variable in shape, mostly ellipsoid to narrowly ellipsoid ($L:W = (1.4-)1.8-2.5(-3.5)$), sometimes narrowed at one or both ends, 10-12(-14) $\times$ (4-)5-6(-8) μm .

SPERMOGONIA immersed; ostioles brownish; **spermatia** filiform, often curved, (10-)20-25 μm long.

SPOT TESTS AND CHEMISTRY: Thallus C-, K-; **cortex** KC+ yellow (usnic acid), P-; **medulla** KC-, P+ yellow (psoromic acid).

DISTRIBUTION AND ECOLOGY: Presently known only from the type collection, growing on limestone; associated lichens include *Aspicilia* sp. and a yellow *Acarospora* species.

DISCUSSION: The species is rather similar to *L. sonorae* Ryan & Nash (Ryan & Nash, 1989) in general appearance and also contains usnic and psoromic acids as the only lichen substances. However, *L. pueblae* differs especially as follows: 1) thallus thinner, more appressed; 2) lobes narrower, more elongated, contiguous, somewhat convex; 3) surface smooth, continuous, and somewhat glossy, with concolorous edges; 4) apothecial discs glossier, often reddish brown; 5) occurrence on limestone rather than siliceous

rock. As with many placodioid *Lecanorae*, the new species is also likely to be misidentified as *L. muralis*, but *L. pueblae* is easily distinguished by cortical structure (lack of distinct conical hyphal bundles) and chemistry (P+ yellow reaction due to psoromic acid; lack of triterpenes). Among the more noteworthy anatomical features of *L. pueblae* are the presence of a distinct hyaline layer over the epihymenium, giving the discs a glossy appearance (as also occurs in *L. sierrae* Ryan & Nash, and a few other species), the lack of a distinct epinecral layer on the thallus and apothecial margin (inspite of their glossiness), and perhaps most unusual, the difference between the apothecial cortex (which contains abundant dead algae) and the thallus cortex (which has few if any). Like *L. sonorae*, the new species is most likely to have its closest affinities with *L. bipruinosa* and similar (undescribed) taxa that also occur in Mexico and have a similar chemistry. Aside from possibly significant (but unclear at present) differences in the structure of the cortex or the excipulum, *L. pueblae* and *L. sonorae* differ obviously from *L. bipruinosa* in the complete absence of pruina on both thallus and discs. Central and southern Mexico are still very poorly known lichenologically, and further explorations may well yield additional material of *L. pueblae*.

***Lecanora kofae* Ryan & Nash, sp. nov.** Figures 3-4).

Type: ARIZONA. Yuma Co.: Kofa National Wildlife Refuge, canyon just west of Kofa Butte, off Road 21, 590 m, Sonoran Desert, with Palo Verde (*Cercidium* spp.), Jojoba (*Simmondsia chinensis*), Cholla (*Opuntia* spp.) and Ocotillo (*Fouquieria splendens*), 34°00'N, 119°40'30"W, on NE facing outcrop on E side, 12 March 1994, Ryan 30873, holotype (ASU), isotypes (ASU, B, BM, BRY, CANL, COLO, FH, GZU, H, M, MEXU, MIN, NEB, O, OSC, UPS, US, VAB, WIS).

In rupibus crescens, Arizona. Subsimilis *Squamarina* (*Petroplaca*) *degelii*, sed thallus complanatis et distinctis rosulatis, lobi

elongator, cortex cum fascis hyphal stratum alborum divisum. Subsimilis *Lecanora bipruinosae*, sed disci apotheciorum epruinosis. Cortex continet acidum usnicum, medulla continet acidum roccellicum.

THALLUS forming distinct, flattened rosettes, to 0.5-1.5 cm across, 0.5 mm thick in center, tightly attached throughout, radiately lobed at the periphery; **thallus center** areolate; areoles more or less contiguous, irregularly rounded to subangular, ca. 0.5-1 mm across, plane; **lobes** contiguous but discrete (separated by narrow but deep cracks), plane to slightly convex, ca. 2-3 mm long, ca. 0.5-1.5 mm wide, ca. 250 μ m thick, subentire to coarsely crenate and incised, the ultimate segments ca. 0.5 mm wide; sharp transverse cracks sometimes present towards the thallus center; apical areas often slightly uneven or coarsely and weakly foveolate; **upper surface** with thin patches of pruina towards the tips of the lobes, matt, pale greenish yellow (104) to grayish greenish yellow (105), in herbarium becoming moderate yellow (87) to grayish yellow (90); **upper cortex** ca. 40-50 μ m thick, mostly interspersed with yellowish brown granules (soluble in K, insoluble in N), conglutinate, apparently true (without dead algal cells), appearing paraplectenchymatous; hyphae somewhat anticlinally oriented, isodiametric to weakly elongated, ca. 3-5 μ m across, with lumina ca. 2 μ m wide, here and there with narrow bundles of elongated, anticlinal hyphae penetrating the algal layer; **algal layer** ca. 50 μ m thick, interrupted; algae trebouxiioid, ca. 10-15 μ m diameter; **medulla** rather dense, filled with coarse and fine grayish granules (insoluble in K and N); hyphae ca. 5 μ m diameter, with narrow, elongated lumina; **lower cortex** not developed except near tips or edges.

APOTHECIA common but not crowded, borne submarginally one per areole, soon sessile, becoming constricted at the base, to 1-1.5 mm diameter; **discs** plane, epruinose, matt to slightly glossy, slightly yellower than moderate orange-yellow (71) or oranger than moderate yellow (87), slightly grayish-greenish next to

margin; **thalline margins** 0.1-0.2 mm wide, becoming flexuous, somewhat raised (more so when young), persistent; **cortex** ca. 40 μ m thick, similar in structure to that of the thallus; **algal layer** filling most of the margin, ca. 75 μ m thick below hypothecium, interrupted; **medulla** distinctly developed only at the base of the apothecia; **excipulum** hyaline, conglomerate; hyphae ca. 3-5 μ m diam., variously oriented, with elongated, 0.5-1 mm wide lumina; **hypothecium** to ca. 50 μ m thick, with narrow bundles of anticlinally oriented hyphae penetrating the algal layer; **subhymenium** indistinctly delimited; **hymenium** ca. 70 μ m high, hyaline; **epihymenium** 15-20 μ m thick, yellowish brown, interspersed with fine granules (soluble in K, insoluble in N), forming a layer extending ca. 10-15 μ m above the paraphyses tips; **paraphyses** rather strongly coherent, mostly simple, ca. 1.5 μ m thick; cells ca. 3-5 μ m long; lumina 0.5-1 μ m wide; tips clavate, scarcely enlarged, hyaline; **asci** clavate, ca. 40 x 10 μ m; **spores** 8 per ascus, simple, hyaline, ellipsoid to broadly ellipsoid (L:W = 1.4-2), with rounded ends, 7-11 x 5-6 μ m.

SPERMOGONIA not seen.

SPOT TESTS AND CHEMISTRY: Thallus K-, C-, P-; **cortex** KC+ yellow (usnic acid); **medulla** KC-, containing roccellic acid.

DISTRIBUTION AND ECOLOGY: Presently known only from the the type locality and nearby sites in Arizona, on vertical to sloping surfaces of smooth siliceous rocks containing or exposed to calcium (HCl+ on the surface, but HCl- inside), in relatively shaded sites or humid microhabitats (two of the collecting sites were in exposed areas but on "tank" rocks with hollow portions that periodically hold water); associated lichens include *L. muralis* (Schreber) Rabenh. (particularly at the type locality) or *L. bipruinosa* Fink (particularly at the other two localities), and species of *Acarospora*, *Aspicilia*, *Caloplaca*, and *Peltula*.

DISCUSSION: This species is superficially somewhat similar to *Squamarina* (*Petroplaca*) *degelii* Poelt, and like that species contains usnic and roccellic acids, but *L. kofae* has a more flattened and distinctly rosulate thallus

with somewhat elongated marginal lobes, and has cortical hyphal bundles dividing the algal layer. *Lecanora kofae* also shows considerable similarities, in external appearance and in cortical structure (true cortex; hyphae scarcely elongated and with rather wide lumina), to forms of *L. bipruinosa* Fink, but has epruinose apothecial discs and consistently small thalli, and the medulla contains roccellic acid, not psoromic acid.

A small amount of *L. kofae* was first collected in 1985 only accidentally (along with numerous specimens of *L. bipruinosa*). The species was locally abundant at least in the vicinity of the type locality, but it is a rather inconspicuous taxon. While the species may also have rather restricted substrate or microhabitat preferences, it should be noted that in the Kofa Mountains lichens in general were found only in the most shaded and humid sites, on the same type of rock on which *L. kofae* was found, perhaps because this kind of substrate is softer and holds moisture better than other rock types in the area. We hope that deliberate searches for *L. kofae* in the future will result in discovery of additional material from other sites in the Sonoran Desert.

OTHER SPECIMENS EXAMINED

U.S.A. ARIZONA. Yuma Co.: Kofa National Wildlife Refuge, dirt road to "Horse Tanks", Sonoran Desert with Ocotillo, Palo Verde, and Cholla, on rock containing or exposed to some calcium, 610 m, 8 January 1985, Ryan 16070, (ASU, GZU). Canyon just west of Kofa Butte, off Road 21, 650 m, Sonoran Desert, with Palo Verde, Jojoba, Cholla and Ocotillo, 34°00'N, 119°40'30"W, on NE face of hollowed out rock, 12 March 1994, Ryan 30865 (ASU, GZU, US).

ACKNOWLEDGEMENTS

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the isotype of *L. pueblae*, and to E. Barreno for accompanying the senior author during the 50 km walk back for help when the pickup truck got stuck near the type locality of *L. kofae*.

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January-March 1995

NOTICE: SALE OF FUNGAL MORPHOLOGY AND ECOLOGY by A. Tsuneda, 1983

Fungal Morphology and Ecology - Mostly Scanning Electron Microscopy by A. Tsuneda, 320 p., 624 fig., 142 ph. pl., 4°, hardcover, 1983. \$25.00 US.

Fungal Morphology and Ecology is now for sale at a very reasonable price. This book originally sold at \$25.00 US, but due to a drastic change in the yen-dollar exchange rate, its recent price had risen to \$60.00 US. This book is now on sale at its original price of \$25.00 US, including handling and postage costs to make it accessible to a wider spectrum of possible readers, including biology teachers and their students.

This mycology illustrates the great diversity of life styles and activities of fungi, using over 600 figures. Most of the figures are SEM or TEM micrographs which are nicely reproduced and delightful to see. The text consists of three chapters: (1) Introduction, (2) Taxonomy and morphology of fungi, and (3) Ecology of fungi. In the Introduction, major characteristics of fungi, especially their cell structures are discussed and illustrated in comparison with those of other organisms. In the second chapter the structure, development, and method of spore discharge of diverse fungi ranging from the Myxomycetes to the Basidiomycotina are shown, using original micrographs wherever possible. Fungi belonging to the hyphomycetes are categorized on the basis of conidium ontogeny. The third chapter deals with such aspects as (i) saprobic fungi and their succession on natural substrates, (ii) fungal interactions with other fungi and other organisms, and (iii) survival in diverse conditions. Important concepts in categorizing the fungal interactions, e.g., antagonism (antibiosis), parasitism, commensalism, and mutualism are discussed and illustrated. Various survival structures are demonstrated in the final section with emphasis on the morphological variations among sclerotia of different genera. Reviews of this work appeared in *Mycotaxon* 20: 685. 1984, and, *Mycologia* 78: 981-982. 1986.

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